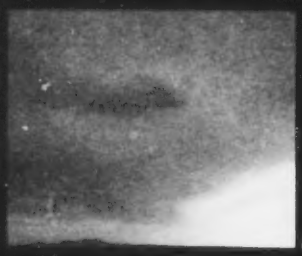
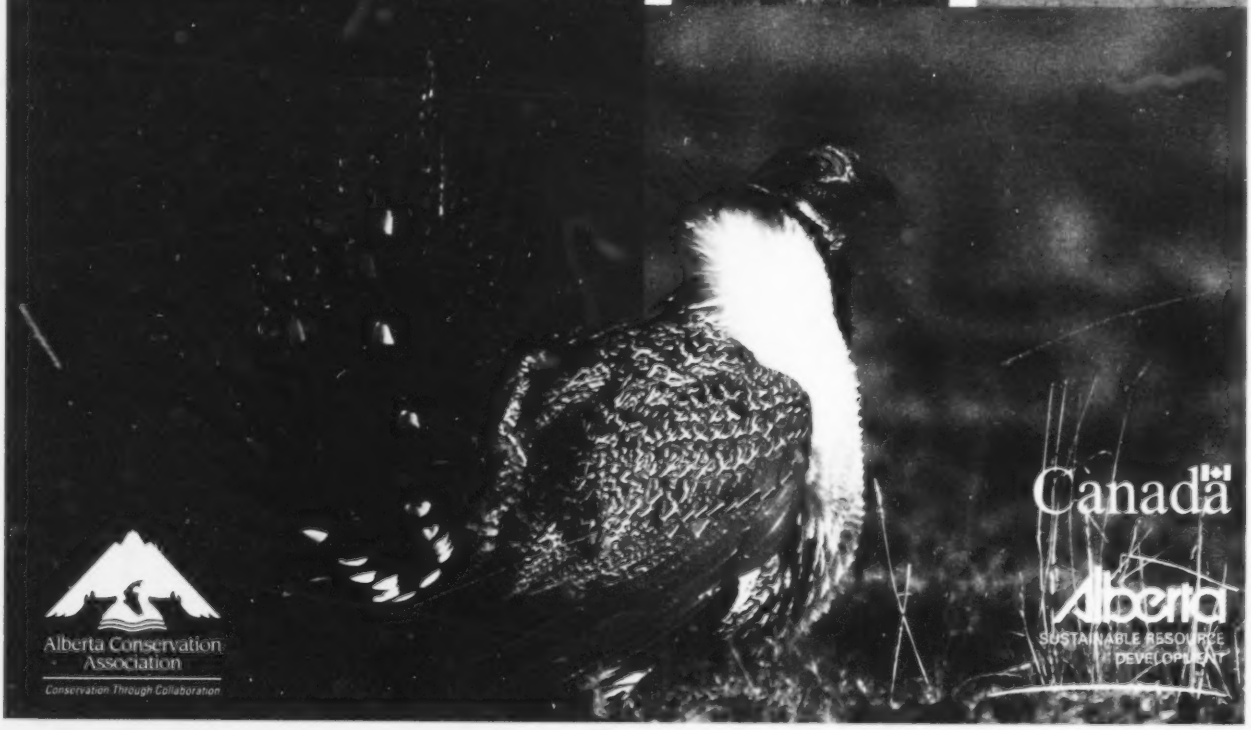
Beneficial grazing management practices for Sage Grouse (*Centrocercus urophasianus*) and Ecology of Silver Sagebrush (*Artemisia cana*) in southeastern Alberta





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Beneficial Grazing Management Practices for Sage-Grouse (*Centrocercus urophasianus*) and Ecology of Silver Sagebrush (*Artemisia cana* Pursh subsp. *cana*) in Southeastern Alberta.

Final Report - January 2004

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Executive Summary

This project was undertaken in support of the Sage-Grouse Recovery Plan. This document is a collection of background material and basic groundwork to begin the process of considering appropriate grazing management for Sage-Grouse, an upland bird species that is in serious decline in Alberta and Saskatchewan. The purpose of the project was to gather existing knowledge about the grazing history and current grazing practices in the Sage-Grouse range area of southeastern Alberta. The report will provide a context for the Sage-Grouse Recovery Team (and perhaps future teams for other species) when considering grazing processes and practices in relation to managing wildlife species on rangelands including species-at-risk.

A review of major events associated with ranching history help to provide context for land managers in viewing the range landscape today. Rangelands were heavily grazed in the early decades of the 1900's until range science and range management practices began to evolve in the late 1920's. The historical record shows an adaptive approach in the development of range management practices since the dust bowl period of the 1930s. This is illustrated with the progressive decline in recommended and actual stocking rates documented for this time period.

The ecology of silver sagebrush (*Artemisia cana*) remains poorly understood. The literature suggests that silver sagebrush has very different characteristics to big sagebrush (*Artemisia tridentata*), the species that is associated with most of the existing knowledge about Sage-Grouse habitat. A number of preliminary sage brush plant communities are described to facilitate the development of ecological site descriptions, an important plant community standard used as a reference in assessing rangeland health. Like grazing, fire was historically significant in the life cycle of silver sagebrush. Despite the historic presence of fire in sagebrush landscapes, the ecological role of fire and value as a management option remains uncertain.

There is very limited information about Sage-Grouse and grazing management in the Canadian context, but a review of the available literature is provided. Sage-Grouse require viable sage brush communities, adequate plant cover to conceal nests, adults and young, forage for hens and young and winter cover. Livestock grazing can impact plant species composition and density, community structure, lead to disturbances to nests and nesting hens, and remove brood forage and cover. Beneficial grazing management practices for Sage-Grouse are reviewed including grazing intensity, livestock distribution practices, onset of grazing, grazing systems and specialized grazing practices. Grazing management should focus on the overall health of the whole range landscape, since Sage-Grouse appear to use all major plant communities identified in the study as part of their annual life cycle.

Acknowledgements

We wish to acknowledge the funding support provided for this project by the Government of Canada Habitat Stewardship Program for Species at Risk. We wish to recognize the staff that have contributed to this project including Darlene Moisey, Richard Ehlert and Lindsay Poulin-Klein of the Rangeland Management Branch of the Public Lands and Forests Division who assisted in data collection and development of plant community types. Thanks also to Paul Jones of the Alberta Conservation Association, Dale Eslinger and Joel Nicholson of Alberta Fish and Wildlife who have helped to develop the project partnership. Numerous ranchers from the study area have shared their knowledge and experience with the project team as well.

Thanks are also extended to Dr. Walter Willms, Agriculture and Agri-Food Canada, Lethbridge; Dr. Simon Evans, University of Calgary; Lorne Fitch, Alberta Fish and Wildlife Division, Lethbridge; and Ron McNeil, Landwise Inc., Lethbridge who provided comments on the interim report. Ranchers Tom Gilchrist of Milk River and Dwayne Good of Irvine provided valuable review comments on the grazing history chapter.

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1.0 Introduction

This report was undertaken in support of the Alberta Sage-Grouse Recovery Plan. The document is a collection of background material and basic groundwork to begin the process of defining appropriate grazing management for Sage-Grouse, an upland bird species that is in serious decline in Alberta and Saskatchewan. The ranching community in southeastern Alberta has played an important role in the development of prairie range management thinking and practices. In the late 1920's, when rangeland degradation was a serious issue, local ranchers worked with the Dominion of Canada to establish the first rangeland conservation studies in the "short grass" prairie. This report gathers the relevant scientific literature, knowledge from the community, agency staff and ranching families, many of whom have three to five generations of experience on the range.

In past decades, ranchers and agency resource managers have worked together on adaptive grazing practices in the southeast in support of basic rangeland health, and for both multi-species and riparian habitat management objectives. With the Sage-Grouse and other recovery plans, ranchers will receive more and possibly conflicting direction on how their range management practices should accommodate the habitat needs of individual species or groups of wildlife species. In this report, we attempt to define the desired outcomes in terms of rangeland health for Sage-Grouse. Ultimately, these recommendations will need to be weighed against the needs of other important species as well as the potential impacts on existing ranching operations. Above all, future success in maintaining or enhancing Sage-Grouse habitat values in the home range area will rely upon the active buy-in and adaptive skills of local ranchers as well as appropriate recognition and support of their voluntary contributions.

1.1 Project Purpose

The purpose of this project is to gather existing knowledge about the grazing history and current grazing practices in the Sage-Grouse area of southeastern Alberta. The report will provide a context for the Sage-Grouse Recovery Team (and other future teams for other species) when considering grazing processes and practices in relation to species recovery objectives.

The Canadian prairie grasslands evolved with the impact of large grazers, especially bison. Both wild and domestic grazers have the ability to modify the composition and structure of grassland plant communities. An improved understanding of grazing processes and management practices is an essential foundation for addressing and integrating the needs of species at risk in rangeland management.

1.2 Objectives:

1. To document the history of livestock grazing in southeastern Alberta and provide a context to current grazing management practices and range health[1] of the Dry Mixed Grass prairie landscape.

2. To develop an improved understanding of silver sagebrush ecology.

3. To develop ecological site descriptions of sagebrush landscapes to serve as baseline standards in evaluating rangeland health within the Sage-Grouse home range area.

4. To develop a literature review of grazing and Sage-Grouse, and, to provide some preliminary definitions of best grazing management practices for Sage-Grouse.

1.3 Status of Sage-Grouse (Centrocercus urophasianus) In South-eastern Alberta

The Sage-Grouse is the largest grouse in North America. The historic range of Sage-Grouse was approximately 49,000 km^2 but they are now confined to the most southeastern portion of the province within a current range of only 4000 km^2. Alberta Sage-Grouse populations have experienced a 66-92 % decline over the past 30 years (Aldridge and Brigham 2001: 2003). The reasons for the decline remain poorly understood, but are mostly attributed to the reduction of habitat quality and quantity which impacts bird survival, especially chicks (Aldridge and Brigham 2002; 2003).

Sage-Grouse depend on the sagebrush-grass range in Alberta year-round to provide both food and shelter (Aldridge 2000, CSGRT 2001). Silver sagebrush *(Artemisia cana)* makes up the majority of Sage-Grouse diets in Alberta, especially in the winter when it may provide nearly one hundred percent of food resources. In springtime, and in the bird's juvenile stage, diets are supplemented by insects and forbs (Aldridge 2000, CSGRT 2001). As well, sagebrush provides one of the only means of protection for birds from weather and predators. Natural predators of Sage-Grouse and their nests are coyotes, ground squirrels, badgers, raptors and gulls (CSGRT 2001).

Though a sagebrush-obligate, specific habitat requirements of Sage-Grouse vary throughout the year. Winter may be the most crucial seasons influencing Sage-Grouse success. They require tall stands of sagebrush where they can feed above snow cover. Sparsely covered saline lowland areas comprise the mating areas or leks. Ideally, these will have adjoining areas of dense cover

---

[1] At the time of writing, a new system of range condition assessment was being implemented in Alberta. Range health refers to the new system which builds on the traditional range condition approach that considers plant community in relation to site potential, and adds new and important indicators of natural processes and functions (Adams et al. 2003).

and taller sagebrush plants for daytime feeding and loafing sites (CSGRT 2001). Nests are almost always located under sagebrush plants and birds prefer taller than average grass cover at these sites (Aldridge 2000). In the US literature, brood rearing sites are comprised of more open, moist areas which allow for increased biomass of forbs and amount of insects.

About 80% of known lek sites in Alberta are present on Public Land and the expectation is that these are relatively well protected from cultivation. Control of silver sagebrush, by chemical or other means, is not an approved or authorized practice on public rangelands, nor is it encouraged by agricultural extension programs on private land.

2.0 Grazing History in Southeast Alberta

2.1 The Pre-European Prairie

Prairie ecosystems have adapted over thousands of years to variation in climate and disturbance especially herbivory and wildfire. Grazing of prairie landscapes by bison and ungulate grazers like antelope and deer was climatically timed which regulated the season, frequency and intensity of grazing. Given the social behavior to congregate into migratory herds, bison were forced to seek new forage and water sources as local supplies became depleted. At times, local impacts from migratory herds would have appeared devastating, with vast landscapes devoid of vegetation, heavy trampling of soils and fouling of water sources with mud and excreta (Roe 1951). The combined impact of aridity, grazing and fire would have reduced tree and shrub cover to the most protected sites where ground water was available to sustain woody growth. But such impact was not constant and would have been interspersed with long periods of recovery. Moreover, moist climatic cycles would result in an increase in the density of ground cover. These contrasting views of prairie condition revealed the cyclic nature of the Canadian prairie and were captured in the accounts of early travellers. John Palliser in 1858-59 and the Canadian Boundary Commission in the early 1870's experienced a dry and desertified prairie landscape (Spry 1963). By the 1880's botanist John Macoun observed a lush prairie with grasses "reaching to a horses belly" (UWC 1991), albeit one where bison had been extirpated.

Given the preference of prairie bird species for a full spectrum of grazing modified communities and levels of use (light, moderate and heavy), many ecologists believe the pre-European prairie was likely a mosaic of different habitat conditions (Bradley and Wallis 1996). Heavily grazed patches may have resulted from grazing every year, resulting in lower cover and little structure. With less frequent grazing and more rest, moderately grazed areas would exhibit more structure and cover. At the lightly grazed end of the spectrum, deeper litter cover, taller graminoids and shrubs would be found where prairie cover might have remained undisturbed for many years (Dale and Prescott 2000). It appears that Sage-Grouse, while adapted to historic herbivory in the landscape, found their habitat requirements met in more lightly grazed conditions.

2.2 Advent of Ranching

Small numbers of cattle were introduced at fur trading posts in northern and central Alberta in the early eighteen hundreds, but it was not until the last two decades of the nineteenth century that cattle ranching became established in the south on a large scale. Domestic cattle were virtually unknown in the southwestern prairie until the bison had disappeared (Eggleston 1955 and Breen 1982). To European immigrants western rangelands appeared lush and productive. Bison had been eliminated from their ancestral home ranges by 1879 and a period of very favorable moisture also prevailed. The rested grasslands produced abundant growth and appeared to provide vast opportunities for livestock production (Johnston 1970). The 130-year period since cattle ranching was first introduced, can be described in broad phases. These phases help us to understand the impacts of domestic livestock grazing over the past century as well as help to interpret what we see today in terms of rangeland condition and management practices.

2.3 Grazing Leases

The period 1880 to 1910 was marked by establishment of grazing leases which attracted large scale ranching operations to the Canadian west (Anderson 1941). In 1881, through Order in Council, the Dominion of Canada made provision for grazing leases to be established in what are now the prairie provinces. The main achievement of the new lease regulations was to attract risk capital to an underdeveloped area - eastern Canadian and foreign capitalists were made an offer they could not refuse.

Grazing leases were granted for up to 21 years, and required stocking up to capacity within three years of being issued. Grazing lease policy established a blanket stocking rate value of 10 acres per AUY[2] (acres per head per year). The stocking rate of 10 acres per AUY was not established to protect the range from overgrazing but rather to ensure that those who had taken out leases utilized them (Evans (2003) Personal Comm.). The policy was aimed at preventing speculation which was rife. Nearly half of the leases that were issued were never occupied or stocked. The stocking provision allowed the government to cancel leases within the first decade of the policy. The Canadian system of leases had been designed to avoid many of the abuses of speculation and free range grazing that had already been witnessed in the US.

Early crown land managers did not appear to grasp the extent to which the initial carrying capacity value of 10 acres per AUY over rated the productivity of western rangelands, nor did the policy recognize the need to adjust for variation in climate and site potential in the region. This stocking level set the stage for overgrazing and degradation of the range landscape. By 1888, several big ranches were flourishing and the cattle industry was, to a large extent, established. Yet, very few of the large ranches were stocked to the required rate. By changing the required stocking rate to 20 acres per AUY, most of the big ranches were able to comply with the grazing lease policy.

2.4 Free or Open Range Grazing

The intent of early grazing lease policy was for allocated lands to be fenced promptly and grazed only by the lease holder's cattle. Early grazing leases were often "legal islands" in a sea of grass (Evans (2003) Personal Comm.). Lease boundaries were irrelevant as neither cattle nor cattlemen had a clear understanding of where the margins of a grazing lease were until they were finally fenced in the decade before WWI. In the seasonal movement of cattle on unfenced range, cattle use could easily overlap without fences to control grazing management. Grazing of open range was based on the laws of "first come, first served", and when the forage supply was exhausted, the herd moved on (Proskie, 1939). One example of this period pertinent to the study, area involved an enforcement action by the North West Mounted Police to discourage US ranchers like the Spencer brothers from drifting their stock across the border to fatten on

---

[2] Today an AUY is the forage required to support a standard Animal Unit (AU) for 12 months; an Animal Unit is considered to be one mature cow of about 1,000 pounds (450 kg), either dry or with calf up to 6 months of age (SRM 1998). In the late 1800s the AU would have been a cow of about 750 lb. (340 kg) so the 10 acre per AUY rate was still heavy but slightly less than if calculated by with the current AU standard.

Canadian pasture (Deane 1916, Evans 1979) in the Milk River area. While free range grazing was a widespread problem in the US ranching frontier, the negative effects of this "commons" style of use was likely relatively localized in Alberta.

2.5 Growth of Ranching and Changes in Livestock Numbers

In the prairie provinces as a whole, numbers of livestock increased dramatically after 1900 building to a major peak in the 1920's (Johnston et al. 1966). As the western rangelands became fully stocked, competition for grazing lands intensified and the free or open range period drew to a close. As the railway progressed through Alberta and branch line expansion occurred, settlement and private ownership in the form of farm homesteads, encroached on pasture lands. *"More and more land was being released by the ranchers to the ever growing number of settlers"* (Proskie 1939). Ranchers began to fence their pastures to control stock use. The 1920's census data for Division 1 (Figure 1), located southeast of Medicine Hat, shows some important overall trends. First, a sharp peak in livestock numbers during the 1920's and 1930's, a sharp decline by the 1950's and a further peak in numbers by the 1970's.

The impacts of the two high peaks in livestock population on rangeland condition would have been very different. The early peak in livestock numbers in the period 1920 - 1930 represented a time of maximum grazing impact on rangelands. Livestock winter feeding practices were not well developed so there would have been greater reliance on native pasture to sustain stock. By the latter half of the century, livestock were supported on seeded pastures, crop residues, irrigated pastures as well as native range.

Along with the sharp decline in livestock numbers in the period of the 1930's to the 1950's, composition of the livestock herd also changed. Horse populations were comparable to cattle numbers in the 1920's but, horse and sheep numbers dropped to very low levels during this time. The contribution of horses to early range degradation is not well appreciated. Horse numbers were very high during these early decades given the reliance on horse power for early farming. Horses can also be wintered on open range and are able to graze rangeland more intensively thus producing negative impacts on range condition on a year round basis.

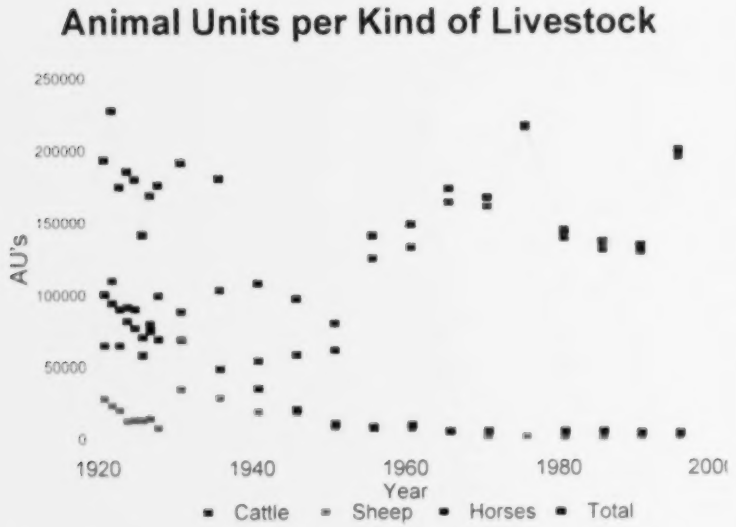

Figure 1 Trend in livestock numbers and animal units for Alberta census Division 1, Southeast Alberta for the period 1920 to 1998.

2.6 Drought, Overgrazing, Rangeland Degradation and Grazing Rates Policy

There is considerable evidence that rangeland condition declined seriously starting about the turn of the century until after the 1930's dust bowl period (Proskie 1939, Johnston et al. 1966, Anderson 1941). A number of factors contributed to unsustainable grazing pressures on rangelands during this period. Settlement pressures began to intensify as Alberta became a province in 1905 along with demand for homestead land. The first two decades of the 20th century were considerably drier than average. While the wettest 15 year sequence occurred between 1888 and 1902 (389 mm), the driest 15 year sequence followed between 1905 to 1918 (289 mm) (Spencer and O'Rielley 2001). As livestock production expanded, numbers increased sharply with rangelands being fully stocked by the end of the first world war (Johnston 1970).

Government grazing lease policy of the day further magnified the pressures of climate and settlement on rangelands (Anderson 1941, Proskie 1939). Grazing lease policy was yet to be science based or to address inherent differences in the productivity of the land. Grazing lease taxation and rental rates were not based on the reasonable economic returns of ranching and therefore there were compelling economic pressures to overgraze. The inequities of the system were felt most strongly in the semi-arid southeast where range pasture productivity is 20% of that on foothills ranges.

Range degradation problems in the early decades of the century, came to a head in the thirties. Dust bowl drought began to intensify starting in 1928. The year's following were very dry and ranges were over-stocked as farmers and ranchers struggled to survive. As livestock numbers peaked in the 1930's stocking rates were decreased to thirty acres per AUY (Johnston, 1970, Proskie, 1939) and then again to 50 acres per AUY (Anderson, 1941). It was reported in the

Province's annual report for 1935-36, that even the new thirty acres per head rate was no longer practical, especially in drought conditions, and that the areas set aside for free public grazing were heavily overgrazed (Alberta, 1935-36). Twin River, the first provincial grazing reserve, was established at this time in response to concerns of drought-stricken farmers in the thirties (Alberta, 1935-36). It was during this time that *"thousands of acres of farmland were returned to the province because of non-payment of taxes resulting from the depression of the dirty thirties"* (Alberta, 1940-41).

In an attempt to address these issues, concerned ranchers formed the Short Grass Stock Growers Association (SGSA) and at their annual meeting in 1938, in Medicine Hat, passed the following resolution:

> *Whereas the cost of grass to leaseholders as charged by the Provincial Government in rent and taxes heretofore has not been based on the productive values of various range areas; .....therefore be it resolved that .....with a view to rating grazing land according to its earning capacity in relation to livestock values, based upon investigations[3] and surveys already conducted in the short grass area."* (Anderson 1941)

In response, the department of Lands and Mines for Alberta commissioned an extensive study of the situation by the provincial grazing appraiser, Graham Anderson, who developed a report with recommendations for better range conservation policies (Anderson 1941). Efforts of the SGSA eventually led to reform of government grazing lease policy, adopting the basic system that exists today based on productivity and market factors.

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[3] Refers to stocking rate and other studies undertaken at the Dominion Range Experiment Station, Manyberries, Alberta starting in 1927.

Photo 1 Overgrazing of prairie rangelands was common in the early decades of the 1900's. Conditions were dry and ranges were over stocked.

2.7 Rangeland Research, Conservation Practices and Adaptive Management

Given the problems of drought and economic viability, the ranching community played an important role in the development of rangeland research which was so desperately needed to guide the grazing practices of the ranching industry. The SGSA appeared to be one of the first forums to promote the new and evolving concepts of range management. An early definition of carrying capacity was provided by SGSA:

> *The committee define "carrying capacity" as the number of cattle which could be grazed in good commercial condition upon the range and preserve the grass, with a reasonable carry-over from year to year (Anderson 1941)*

The Dominion Experimental Farms Service established the first rangeland research program in Canada at Onefour, near Manyberries Alberta. *"This station was established at the request of the stockmen in 1927 by the Dominion Department of Agriculture, in cooperation with the Gilchrist Brothers of Wildhorse, Alberta"* (Hargrave 1949). The research program provided the first scientifically based guidelines on stocking rates and range management practices in the country.

A time line is provided in section 2.9 to summarize the major events that define the evolution of range management practices in the Southeast. The trend in recommended stocking rates is

summarized in figure 2 with trend in acres per AUY[4] plotted over time (as values increase stocking rates are lighter).

As range management knowledge has developed, stocking rates on public lands in the southeast have become progressively lighter. Following the adjustments made in the 1930's downward to 30 and then 50 acres per AUY, recommended rates were set at about 60 acres per head by the 1960's and then to an average rate of about 90 acres per AUY by the 1990's. Stock return records[5] provide information about actual use levels on grazing leases in the Sage-Grouse area. The trends in actual stocking rates for six large leases are presented in figure 2 against the trend in recommended rates. Actual use has averaged between 80 and 120 acres per AUY in recognition of the limiting factors associated with blowout range sites in the local landscape (see section 2.0). The bold line portrays the recommended carrying capacity of successive government agencies starting with the Dominion of Canada until 1930 and thereafter by the Government of Alberta.

The period of the 1960's to present can be described as a period of adaptive management on rangelands in the southeast. Basic range conservation principles and practices have been defined as range management knowledge has grown through research and ranch experience. Key elements of this knowledge and practice include:

- Recognition by ranchers of the need to manage carryover, to maintain protective litter on the surface of the range, to stabilize production and reduce drought impacts;
- New ecologically based range survey methods (Wroe 1968) were introduced in the 1960s that challenged assumptions about stocking rates. The original rates were based on forage yield data and untested assumptions about proper grazing utilization (assumed that 50 to 60% was sustainable), leading to recommendations for lighter rates.
- The development of management tools like the "Guide to Range Condition and Stocking Rates for Alberta Grasslands" helped producers and resource managers to estimate initial stocking rates in relation to range condition. Stocking rates could be set to balance the need to maintain a desired plant community and also adjust for differences in climate and soil type (Johnston et al. 1966);
- Agency staff and ranchers have carried out more frequent and intensive monitoring of range condition and litter reserves on rangeland.
- Agency staff have allocated grazing capacity to wildlife on many grazing leases

---

[4] AUY (Acres Per Animal Unit Year) represents the area of rangeland allocated to graze an animal unit (mature cow with or without a calf) for one year. A trend from smaller to larger values implies a move towards a lower grazing intensity.

[5] Stock return forms are submitted by grazing lease holders each year to the Rangeland Management Branch, Public Lands and Forests Division as a record of livestock use for a grazing lease. Stock return information is used to help achieve long-term sustainable grazing levels on each grazing lease.

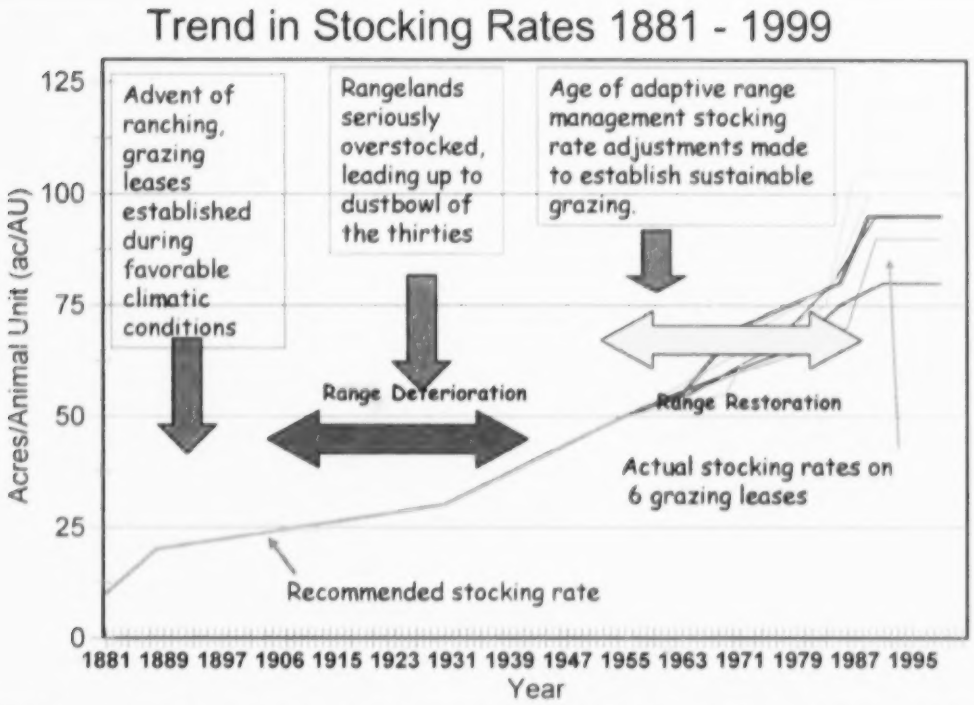
Trend in Stocking Rates 1881 - 1999
Advent of ranching, grazing leases established during favorable climatic conditions
Rangelands seriously overstocked, leading up to dustbowl of the thirties
Age of adaptive range management stocking rate adjustments made to establish sustainable grazing.
Range Deterioration
Range Restoration
Actual stocking rates on 6 grazing leases
Recommended stocking rate
Acres/Animal Unit (ac/AU)
125
100
75
50
25
0
1881 1889 1897 1906 1915 1923 1931 1939 1947 1955 1963 1971 1979 1987 1995
Year

Figure 2 Trend in recommended stocking rates from 1881 to 1999 and actual stocking rates from the 1950's to present on a selection of six large grazing leases in southeastern Alberta.

2.8 Early Ecological Studies and Grazing History

Prior to the 1980's, the brown soil zone in Alberta was first described as "short grass" prairie, implying an ecological link to the short grass steppe of interior plains and a dominance of warm season species like Blue grama grass. The ecological literature strongly supports the historical profile of grazing impacts outlined in this chapter. Heavy grazing during the early decades of the 1900's established a broad landscape level of impact on grassland plant communities that was recognized by early plant ecologists. When Coupland (1961) reflected on the works of Clark et al. (1942) and Hubbard (1950), and then on his own initial plant community studies (Coupland 1950), he concluded that the use of the term "short-grass" prairie was a misnomer. He observed that early studies that defined Blue grama dominated communities were carried out after a period of poor moisture conditions and the abundance of Needle-and-Thread grass had been reduced by grazing pressure, much more so than early investigations had recognized. In other words, the earlier investigators observed a desertified range landscape by the 1930's. Since that time, mid grasses like Needle-and-Thread, Porcupine grass, Northern and Western wheatgrass have become far more abundant on the landscape, establishing dominance on almost all range sites over the decumbent, low-growing, grazing-resistant Blue grama. Today the brown soil zone is more appropriately described as the mixed grass prairie, implying the important presence of mid-grasses.

Photos 2 and 3 These photos illustrate Coupland's conclusion that the term "Shortgrass Prairie" was a misnomer. The grassland in photo 1 (above) shows a marked reduction in mid-grasses like Needle-and-Thread grass, from past heavy grazing pressure. Grassland in photo 3 (below) has a normal dominant cover of Needle-and-Thread grass typical of mixed grass prairie.

2.9 Summary

Based on the accounts of early travelers and the habitat requirements of many prairie wildlife species, the pre-European prairie would have exhibited considerable variation in landscape condition. The impacts of grazing and fire were climatically timed and periods of high impact were offset by variable rest periods. Ranching became established in southeast Alberta in the last decades of the 1800's. With the bison eliminated from its ancestral home, along with relatively light grazing pressure and above average precipitation, the western prairies appeared lush and productive with great potential for livestock production. Overgrazing began in the early decades of the 1900's with drier climatic conditions and rangelands fully occupied by domestic livestock. The problem of range degradation was further compounded by stocking rate policies that failed to adjust for range productivity or variation in climate. Research studies to define sustainable stocking rates began in southeastern Alberta in 1927 and the depredations of the dust bowl years further highlighted the need for this information. Since the 1940's, changes in grazing lease policy, range management practices, and a philosophy of adaptive management has lead to progressively lighter stocking levels on southeastern Alberta rangelands. Early plant ecology studies reflected the impacts of grazing management on the range landscape. In the early decades of overstocking, the prairie resembled short grass steppe. As grazing management and climatic conditions improved after the dust bowl period, the prairie has regained its mixed grass character.

2.10 Time line - Major Events
Domestic Grazing and Range Management in South-eastern Alberta

1879 Bison extirpated from southern Alberta

1881 Dominion of Canada passes legislation allowing 20 year grazing leases on up to 100,000 acres at 10 acres per AUY (Anderson 1941).

1888 Dominion of Canada reduces required grazing rates to 20 acres per head given concerns for sustainability of the stocking rate.

1888 to 1902
Wettest 15 year sequence at Medicine Hat during the period 1883 to 1999 (389 mm) (Spencer and O'Rielly 2001)

1900 to 1910
Homesteading results in entries into the grazing lease land base

1905 to 1918
Driest 15 year sequence at Medicine Hat during the period 1883 to 1999 (289 mm) (Spencer and O'Rielley 2001).

1910 to 1935
Extensive and heavy grazing of native rangelands in the dry-mixed grass prairie

1927 Experimental farms program establishes range and livestock research program at the Onefour Substation, near Manyberries, AB in cooperation with local ranchers (Anderson 1941).

1930's Stocking rates adjusted to 30 acres per AUY but noted in the Province's annual report of 1935-36 that even this rate is no longer practical or achievable.

1939 Report of the "Shortgrass Grazers" demanding better grazing policies that reflect the lower productivity of the rangelands in the brown and dark brown soil zones (Anderson 1941, Proskie 1939).

1945 Province of Alberta implements grazing lease policy that bases rental and tax rates on carrying capacity and sale value of livestock (Hargrave 1949)

1947 Results of grazing studies at Manyberries recommend a carrying capacity value of 50 acres/head and that the "most important factor in sound range management is to be conservative grazing" (Hargrave 1949).

1950' and 1960's
Southeast Grazing Leases are rated 50 to 60 acres per head.

1966 First stocking guide published for grassland natural region recognizing differences in carrying capacities according to local differences in climate and soil (Johnston et al. 1966).

1968 Application of new range survey methods results in carrying capacity estimates for rangelands in the southeast at over 100 acres/head (Wroe 1968).

1969 First rangeland reference areas established in the prairie area of the southern region including Onefour and Pinhorn.

1970's Adaptive approach taken in adjusting lease stocking rates to conserve range condition and residual cover (litter).

1980 to Present.
Stocking rates further reduced to the current operating range of 80 to 120 acres per head.

1988 Sixth edition of the "Stocking Guide" recognized a 6 to 10 inch precipitation zone south of the Cypress Hills and made provision for recommend carrying capacity values of 80 to 140 acres per head for blowout range sites in the dry mixed grass prairie (Wroe et al. 1988).

1988-92 Public Lands and Fish and Wildlife cooperate to identify and allocate Animal Unit Months of grazing to wildlife, especially Pronghorn Antelope including 2684 Animal Unit Months's on 181,000 acres (Cairns and Clark pers. comm.).

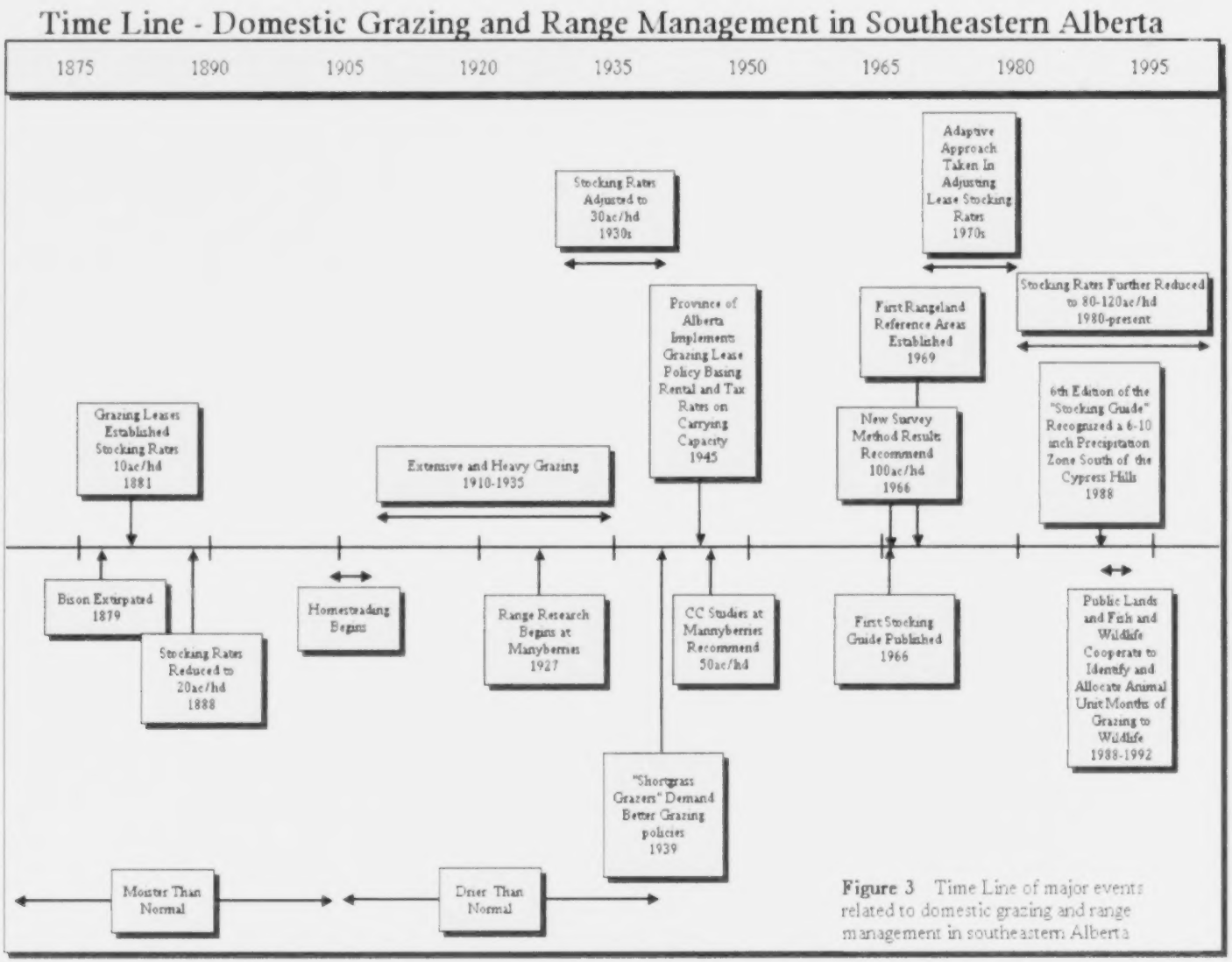
Time Line - Domestic Grazing and Range Management in Southeastern Alberta
1875
1890
1905
1920
1935
1950
1965
1980
1995
Grazing Leases Established Stocking Rates 10ac/hd 1881
Bison Extirpated 1879
Stocking Rates Reduced to 20ac/hd 1888
Homesteading Begins
Extensive and Heavy Grazing 1910-1935
Range Research Begins at Manyberries 1927
Stocking Rates Adjusted to 30ac/hd 1930s
Province of Alberta Implements Grazing Lease Policy Basing Rental and Tax Rates on Carrying Capacity 1945
CC Studies at Manyberries Recommend 50ac/hd
"Shortgrass Grazers" Demand Better Grazing policies 1939
Wetter Than Normal
Drier Than Normal
First Rangeland Reference Areas Established 1969
New Survey Method Results Recommend 100ac/hd 1966
First Stocking Guide Published 1966
Adaptive Approach Taken In Adjusting Lease Stocking Rates 1970s
Stocking Rates Further Reduced to 80-120ac/hd 1980-present
6th Edition of the "Stocking Guide" Recognized a 6-10 inch Precipitation Zone South of the Cypress Hills 1988
Public Lands and Fish and Wildlife Cooperate to Identify and Allocate Animal Unit Months of Grazing to Wildlife 1988-1992

Figure 3 Time Line of major events related to domestic grazing and range management in southeastern Alberta

3.0 Ecology of Silver Sagebrush and Sagebrush Plant Communities in the Sage-Grouse Area of Southeastern Alberta

3.1 Characteristics of Silver Sagebrush

Silver sagebrush (*Artemisia cana* Pursh subsp. *cana*) is an erect, freely-branching, aromatic shrub that reaches 0.1 to 1.5 meters in height depending on site conditions. The shrub has a deep tap root as well as rhizomes that produce vegetative sprouts (Walton 1984). Establishing in early seral stages, sagebrush persists through late seral stages. Mature stands are indicative of climax communities (potential natural community). Silver sagebrush provides valuable plant community structure for many wildlife species in the dry mixed grass prairie environment.

Though silver sagebrush is a prolific seed producer, and well adapted to being spread by animals and transported soil particles, few seeds will germinate and survive to viability (Cosby 1964). Most shrub regeneration is vegetative in origin (Coupland 1950, Kelsey 1986) by layering, rhizomes and root sprouts. Layering is especially important on overflow or flood plain sites where vegetative branches are covered by sediment and from which new sprouts emerge (Bunting 1985).

In terms of nutritional value, silver sagebrush is rated as fair for energy and fair to good for protein value (Dittberner and Olson 1983). Sagebrush is an important food source for Sage-Grouse which utilize seeds, foliage and vegetative sprouts. The value and preference for the species by livestock remains poorly understood especially given the presence of aromatic oils which are normally a negative factor in terms of forage palatability. Though a number of sources suggest that silver sagebrush is both an excellent winter forage for cattle and sheep and increases with grazing (Wilson 1977), there is little evidence to support this conclusion especially under environmental conditions in southeastern Alberta. Thorpe and Godwin (1997) found that cattle grazing in the Great Sand Hills of Saskatchewan, made almost no use of silver sagebrush during summer or winter. It is likely that cattle use of silver sagebrush communities is more closely associated with grazing of herbaceous understory species or preferred browse, as opposed to preferential use of the foliage and twigs of the shrub. Reductions in the density and canopy cover of silver sagebrush stands may occur with confined livestock feeding, where cattle may be more concentrated than when grazing open range.

While brush management practices have been developed for other species of sagebrush in the United States, there are no examples of brush control measures for silver sagebrush in Canada, nor any record of specific silver sagebrush management projects on public rangelands in southern Alberta (Public Lands and Forests Division, Rangeland Management Branch, Medicine Hat).

3.2 Major Range Sites/Soils Occupied by Silver Sagebrush

Thompson and Hansen (2002) described the Silver Sagebrush-Western wheatgrass plant community as the driest of riparian plant community types. Within the landscape, silver sagebrush is most common on alluvial fans, aprons, terraces, broad poorly-defined swales and

glacial meltwater channels. Silver sagebrush has a particular affinity to these overflow sites where episodic runoff events provide more water and sediment than typical for well drained uplands under dry mixed grass climatic conditions (McNeil and Sawyer, 2001). Deposited sediments are rich in sodium sulphate salts derived from soil parent materials associated with Bearpaw shale (marine). The tendency for internal drainage in the Pakowki basin produces sodic and saline soils, providing growing conditions favourable to sagebrush as salts are concentrated by evaporating water (McNeil 1996). Both sodicity and sediment deposition will favour sagebrush reducing the competitive edge that grasses normally have in the semi-arid environment. An example of how changes in surface drainage can provide overflow conditions suitable for silver sagebrush is provided in photo 4. This canal breach occurred in the mid 1960s giving rise to the unusual landscape position of the current silver sagebrush stand. See Thorpe (1997) for a thorough over view of silver sagebrush communities in a broader prairie context.

McNeil and Sawyer (2001) have defined a soil development sequence for the Sage-Grouse area, that provides a useful framework for recognizing key ecological sites. The soil development sequence is represented in Figure 4, portraying an upland to lowland drainage sequence. These soils can be further grouped by generic range site categories as follows:

Saline Lowlands - swales and depressions, sites with the poorest growing conditions being saline Orthic Regosolic soils, soil series Scotfield and Weston (WTNaa), poorest soil development, highest salinity, locally referred to as "popcorn" clays.

Overflow Sites (sodic/saline) - on aprons, fans and post-glacial drainage channels with Orthic Regosols like Orion (ORN) poorly developed soil but less saline than Weston.

Overflow Sites (non-saline) - a rare non-saline overflow site was encountered with Orthic Dark Brown soils developed in north sloping swales that receive overflow from spring snow melt.

Blowout Sites - these are upland soils where overflow and periodic ponding is associated with blowout pits that characterize surface expression of solonetzic soils. Solonetzic soils here range from Brown Solonetz - Bullpound (BLP); Brown Solodized Solonetz - Wardlow (WDW), Duchess (DHS), Hemaruka (HUK), Steveville (SIL); Brown Solod - Karlsbad (KBD), Gem (GEM), Halliday(HDY)

Loamy Sites - these are well-drained upland soils termed "loamy" or "normal" since they produce plant communities that are a zonally normal expression of site potential given local climatic conditions. Loamy sites include Brown Chernozems including: Solonetzic Brown Chernozem - Chinz (CHZ), Ronalaine (ROL), Tilley (TIY); Orthic Brown Chernozem - Bunton (BUT), Cranford (CFD), Chin (CHN), Maleb (MAB), Masinasin (MSN)

Figure 4 Soil development sequence for blowout, overflow and saline lowland soils in southeastern Alberta.

Photo 4 A silver sagebrush community established over four decades at the breach in a canal, creating overflow conditions. Though the canal is not in use the breach redistributes local rainfall and snow melt (McNeil - Personal Communication).

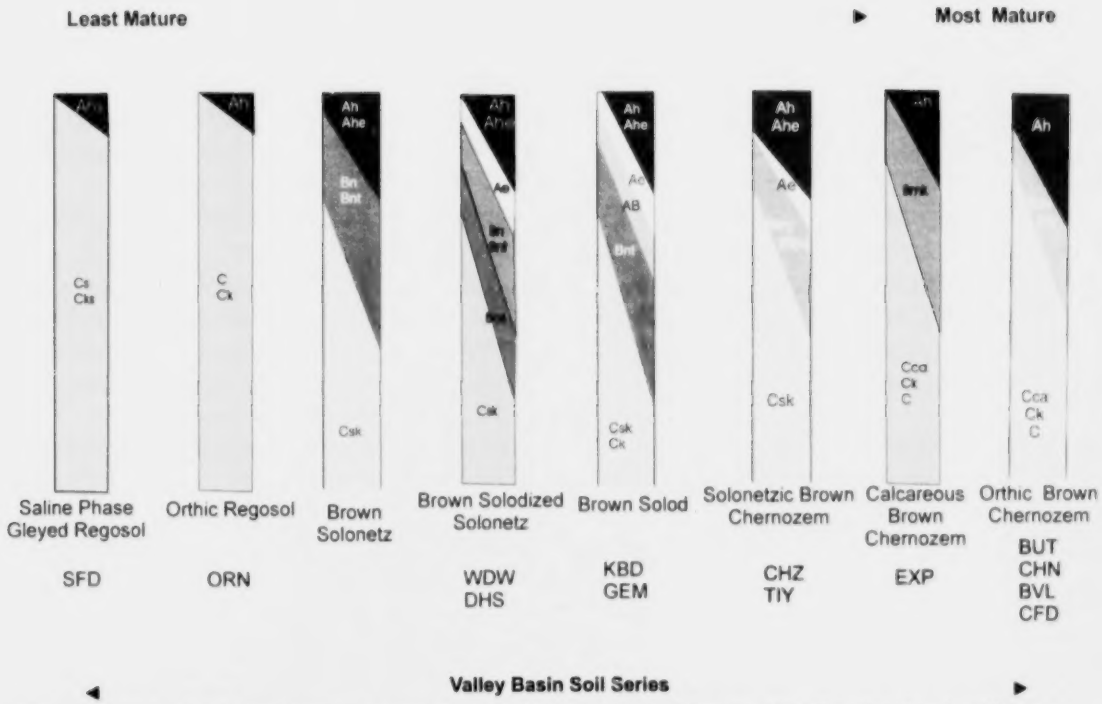

Figure 4 Soil development sequence for blowout, overflow and saline lowland soils in southeastern Alberta.

Photo 4 A silver sagebrush community established over four decades at the breach in a canal, creating overflow conditions. Though the canal is not in use, the breach redistributes local rainfall and snow melt (McNeil - Personal Communication).

3.3 Silver Sagebrush Plant Communities and Range Health Assessment

Resource managers require a landscape-based plant community framework or classification of ecological sites (habitat types) to be able to recognize current resource condition and potential. Alberta Sustainable Resource Development has implemented a new system of rangeland health assessment in the Province of Alberta (Adams et al. 2003, Willoughby et al. 1999) that will be useful in planning and monitoring grazing management practices to maintain or enhance Sage-Grouse habitat. Plant community types derived in this study are preliminary but will allow managers to apply the new range health protocol as a coarse filter for evaluating the health status of rangelands within the study area. Future refinements to these plant community types will be recorded in the range plant community guide for the Dry Mixed Grass Natural Subregion (Adams et al. 2004).

Weerstra (2002) has developed a preliminary classification of silver sagebrush (*Artemisia cana*) community types for the Grassland Natural Region of Alberta. The initial classification includes nine herbaceous-shrub types and three shrub types. An important community described in Weerstra's review includes a major shrub type, Silver Sagebrush/Western Wheatgrass (*Artemisia cana/Agropyron smithii*) which was defined by Thompson and Hansen (2002) in the development of a riparian plant community classification for the Grassland Natural Region of Alberta. Thorpe and Godwin (2003) noted that *Agropyron smithii* was not always the dominant wheatgrass in silver sagebrush plant communities in southwestern Saskatchewan and that *Agropyron dasystachyum* would often share dominance with no obvious environmental reason. See Thorpe (1997) for a thorough over view of silver sagebrush communities in a broader prairie context.

3.4 Vegetation Inventory Methods

In consultation with the Sage-Grouse research team, representative ecological sites were selected because of their use by Sage-Grouse for breeding, nesting and brood rearing. Sites were selected in proximity to both active and inactive leks, recognizing that nesting and brood rearing sites are the most important to the study at hand and issues related to nest and chick survival.

Using GPS coordinates for navigation, the survey team navigated to within 10 meters of the site of interest (lek, nest, brood rearing site) and located a vegetation sampling transect that bisected the site. Then at each of the ten sample points, a 20 x 50 cm Daubenmire frame was nested within a meter square frame which was further divided into 0 .25 meter units. Ten vegetation sampling points were then located along the transect at 20 m intervals. At each transect, vegetation species cover, soil exposure, moss/lichen cover and total vegetation cover were recorded in 10 Daubenmire plot frames located at paced intervals along the transect line (Robertson and Adams 1990). The cover of Silver sagebrush was estimated within ten, one meter square frames and total standing crop of litter was hand raked from ten 0.25 meter square quadrats. Field data was recorded on standard range survey field sheets employed by Alberta Sustainable Resource Development (MF5 Vegetation Inventory Form). A total of 48 transects were sampled, 27 during the last two weeks of July 2001 and a further 21 during July 2002.

3.5 Plant Community Classification Methods

All data records were reviewed for completeness, species seven letter codes were assigned along with a unique identifier number for each transect. Data from the field sheets were then entered into the Priaire Data Base (Rangeland Management Branch, Alberta Sustainable Resource Development). The data base calculates mean values for species composition, total vegetation, moss/lichen and bare soil cover.

The results of vegetation transect queries were extracted from the Prairie Data Base and formatted for analysis in a two dimensional matrix in the *.wk1. format that PC-ORD requires. Ordination and classification studies were carried out on the data sets using PC-ORD (MJM Software, Gleneden Beach, Oregon). The corresponding "land data" including soils and site information, were sorted into a corresponding land data matrix. A total 48 vegetation inventory plots were extracted from the Prairie Data Base for classification and analysis.

In order to establish major plant community types ordination and classification interpretations were developed by using two statistical procedures (Willoughby 1997):

- De-trended Correspondence Analysis was applied (Gauch 1982). This procedure compares similarity and dissimilarity among sites. Plotting of the ordination scores in three dimensional "species space", allows viewing of site and species distributions and facilitates grouping of sites by community types.

- A cluster analysis procedure was employed as an alternate grouping technique to compare and contrast with the results of the DCA procedure. Ward's method of cluster analysis was the most easily interpreted from the six or more procedure that might be chosen.

Plant community type summaries were generated in Quattro 9, by averaging plant species composition, range in composition and percent constancy of occurrence among groups of plots considered to form a unique plant community type. Strong has suggested (Adams et al. 1997) that only species with a 40% frequency be included in the final summaries.

3.6 Results of Ordination Studies - Preliminary Plant Community Types

Of the 48 plots analysed in the ordination, seven plant communities (table 1) were defined including two saline lowland types, two overflow types, two upland types and one badland type. In the pages following table 1, a detailed summary of each plant community type and photographs of each type is provided. The summary includes plant species composition, dominant site and soil attributes along with a detailed narrative describing successional features and previous information about the type.

Some basic distinctions among the six plant community types are as follows:

a.) The two **saline lowland** types and the single **badland** type are characterized by the lowest total vegetation canopy and the highest cover of bare soil. The saline lowland

types have little vertical horizontal structure but creeping juniper does provide importan structure on the badland type.

b.) The two **overflow** sites produced the tallest shrub structure and since they receive extra water through surface overflow, are the most mesic in character.

c.) The two upland types are broadly representative of the majority of the upland range sites including normal brown chernozemic soils (**loamy**) or brown solonetic soils (**blowout**).

3.7 Grazing Management Considerations and Future Research Issues

Of the seven community types, the two saline lowland types and the badland type would be considered to contribute very little in the way of grazable forage and so should be rated according to the very conservative carrying capacity values suggested. The majority of grazable forage on most ranching operations will be provided by the loamy and blowout types. At the present time, carrying capacity estimates for the two overflow sites are poorly defined. Rangeland reference areas should be established in the near future within the study area, allow long-term monitoring of plant species composition, and plant community productivity and to establish litter normals. Litter data is necessary for completing range health assessments and establishing minimum litter requirements.

A recent study raises concern for the current status and productivity of silver sagebrush communities on overflow sites. A study by McNeil and Sawyer (2003) revealed that both climatic patterns and man made dams and dugouts have likely reduced the moisture supply to overflow, swale and gully environments that normally provide the best growing conditions for silver sagebrush. Precipitation events, defined as 60 mm falling within a five day period, were recorded at Onefour once every 2.2 years from 1935 to 2002 except for the period 1978 to 1995 when only one event was recorded in 1986. Air photo interpretation indicated that the number of drainage impediments increased by four-fold between 1951 and 2001. The study concluded that sagebrush habitats may have been compromised by the low number of precipitation events between 1978 and 1995 and by the dramatic increase in drainage impediments since 1951.

At the time of writing Aldridge (personal comm.) is completing a correlation of ecological range sites, as defined in this study, with life cycle activities of Sage-Grouse. There is one overarching difference between research in the US in big sagebrush habitats vs. silver sagebrush habitat in southeastern Alberta. In the US, management emphasis appears to be focused primarily on the most productive elements of the landscape in big sagebrush stands. In southeastern Alberta, Sage-Grouse appear to utilize all plant communities in the landscape. Therefore, the management emphasis should focus on the landscape as a whole.

Table 1 Preliminary Silver Sagebrush plant communities in southeastern Alberta.

Plant Community	Range Site	n=plots	Carrying Capacity Ac/AU	Value to Sage-Grouse
Silver Sagebrush/Wheatgrass - Nuttali's Atriplex *(Artemisia cana/Agropyron spp. - Atriplex nuttallii)* Shrub herbaceous	Saline Lowland	n=8	nil	Lek sites - breeding
Silver Sagebrush/ Undifferentiated Wheatgrass *(Artemisia cana /Agropyron spp.)Herbaceous shrub*	Saline Lowland	n=4	nil	Lek sites - breeding
Silver Sagebrush/Western Porcupine Grass - Sedge *(Artemisia cana/Stipa curtiseta - Carex spp.)* Herbaceous shrub	Overflow (non-saline)	n=1	60-80	Nesting and brood rearing (high value)
Silver Sagebrush/ Western and Northern Wheatgrass *(Artemisia cana - Agropyron smithii and dasystachyum)* Shrub herbaceous	Overflow (saline)	n=2	48-60	Nesting and brood rearing (high value)
Silver Sagebrush/Northern Wheatgrass - Blue Grama Grass *(Artemisia cana/Agropyron dasystachyum - Bouteloua gracilis)* Herbaceous shrub	Blowout	n=10	80-140	Nesting and Brood rearing (medium to high value)
Silver Sagebrush/Needle and Thread - Blue Grama *(Artemisia cana/Stipa comata - Bouteloua gracilis)* Herbaceous shrub	Loamy	n=8	60-80	Brood rearing (medium to low value)
Creeping Juniper/Sedge	Blowout	n=2	nil	Nesting (medium value)

***3.8 Sagebrush Community Type Summary (see pages* 23 to 29).**

COMMUNITY TYPE 1

Silver Sagebrush/Wheatgrass - Nuttall's Atriplex

(Artemisia cana/Agropyron spp. - Atriplex nuttallii) Shrub herbaceous

n=8 The Silver Sagebrush/Wheatgrass - Nuttall's Atriplex community type (shrub/herbaceous) is a late seral to PNC community type associated with **saline lowlands** in the dry mixed prairie and soil correlation area 1. This community is found in depressional areas and level plains with periodic ponding of water and high sodicity. Soils are poorly developed Saline Regosols or Alkaline Solonetz, developed on fluvial and lacustrine parent materials. Drainage is generally imperfect to moderately well drained with textures ranging from silt loam to silty clay. Productivity data are not available for this type but average total annual yield of grasses and forbs would likely be less than 100 lb/ac. Based on one years data (2001) litter residue is estimated at 158 lb/ac. As soils continue to develop from a Saline Regosol to Alkaline Solonetz (expressed as slightly better soil drainage and the appearance of weak columnar structure) plant succession will proceed to the Silver Sagebrush/Wheatgrass (Saline lowland) type which has significantly more vegetative cover and less soil exposure. Saline lowlands are commonly used as strutting grounds where Sage-Grouse courtship and breeding activities occur - given the barren site characteristics and lack of plant community structure. Silver sagebrush takes on a dwarfed stature on this type averaging only .1 m in height.

Soil Exposure: 75 % (60-90) **Moss/Lichen Cover:** 4 % (.2 - 11) **Total Vegetation:** 26% (13 - 38%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
SILVER SAGEBRUSH *(Artemisia cana)*	4	1-10	75
FORBS			
NUTTALL'S ATRIPLEX *(Atriplex nutallii)*	2	1-6	75
FRINGED SAGEWORT *(Artemisia frigida)*	1	0-3	67
GRASSES			
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	2	0-10	88
WESTERN WHEATGRASS *(Agropyron smithii)*	2	0-11	63
BLUE GRAMA GRASS *(Bouteloua gracilis)*	3	0-12	50
UNDIFFERENTIATED SEDGE *(Carex)*	2	0-5	50
SANDBERG BLUEGRASS *(Poa sandbergii)*	1	0-3	100
JUNE GRASS *(Koeleria macrantha)*	1	0-3	67
NEEDLE ANDTHREAD *(Stipa comata)*	1	0-5	67

ENVIRONMENTAL VARIABLES

RANGE SITE
SALINE LOWLAND

SOILS
SALINE ORTHIC REGOSOL (SCOTFIELD, WESTON-AA)

ELEVATION:
850-975 M

SOIL DRAINAGE:
IMPERFECTLY TO MODERATELY WELL

SLOPE :
LEVEL AND DEPRESSIONAL

ASPECT:
N/A

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	158 (50-350)
TOTAL	NOT AVAILABLE

Suggested Grazing Capacity
nil Ac/AU

COMMUNITY TYPE 2

Silver Sagebrush/ Undifferentiated Wheatgrass

(Artemisia cana / Agropyron spp.)Herbaceous shrub

n=4 The Silver Sagebrush/ Undifferentiated Wheatgrass type is a late seral to PNC community type associated with **saline lowlands** in the dry mixed prairie and soil correlation area 1. This community is found in depressional areas and level plains with periodic ponding of water and slightly lower salinity than the Silver Sagebrush/Undifferentiated Wheatgrass type. Drainage is generally imperfect with textures ranging from silt loam to silty clay. Productivity data are not available, but this type will likely yield significantly more herbage than the previous type given the increase in wheatgrass density and cover. Litter residue is estimated at 277 lb/ac. This type is correlated with slightly better developed soils (alkaline solonetz, lower salinity and weak development of columnar structure) compared to the Silver sagebrush/ Undifferentiated Wheatgrass - Nuttaill's Atriplex type and also has significantly more vegetative cover and less soil exposure. This type may be less attractive as a strutting site for Sage-Grouse courtship activities given greater vegetation ground cover. Silver sagebrush has a dwarfed growth habit on this type as well.

Soil Exposure: 39%(31-49) **Moss/Lichen Cover:** 21%(12-32) **Total Vegetation:** 57%(42-83)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SILVER SAGEBRUSH			
(Artemisia cana)	2	0-7	50
FORBS			
NUTTALL'S ATRIPLEX			
(Atriplex nutallii)	1	0-5	50
FRINGED SAGEWORT			
(Artemisia frigida)	3	0-12	50
GRASSES			
NORTHERN WHEATGRASS			
(Agropyron dasystachyum)	4	0-10	75
WESTERN WHEATGRASS			
(Agropyron smithii)	4	0-11	75
BLUE GRAMA GRASS			
(Bouteloua gracilis)	3	0-12	50
SALT GRASS			
(Distichlis stricta)	4	0-15	25
ALKALI GRASS			
(Puccinellia spp.)	3	0-13	25
UNDIFFERENTIATED SEDGE			
(Carex spp.)	2	0-5	25
BLUEGRASS			
(Poa spp.)	2	0-6	25
JUNE GRASS			
(Koeleria macrantha)	1	0-2	75
SANDBERG'S BLUE GRASS			
(Poa sandbergii)	0	0-2	75

ENVIRONMENTAL VARIABLES

RANGE SITE
- SALINE LOWLAND

SOILS
- ORTHIC REGOSOL (ORION)
- ALKALINE SOLONETZ(BULLPOUND)

ELEVATION:
- 850-975 M

SOIL DRAINAGE:
- WELL DRAINED
- MODERATELY WELL DRAINED
- IMPERFECTLY DRAINED

SLOPE :
- LEVEL DEPRESSION

ASPECT:
- LEVEL

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	277 (30-700)
TOTAL	NOT AVAILABLE

Suggested Grazing Capacity
nil Ac/AU

COMMUNITY TYPE 3

Silver Sagebrush/Western Porcupine Grass - Sedge

(Artemisia cana/Stipa Curtiseta - Carex spp.) Herbaceous shrub

n=1 This type occupies **non-saline overflow** sites and is likely fed by meltwater from major snowdrift areas. The presence of vigorous and productive stands of Western porcupine grass is an indicator of productive, dark brown chernozemic soils (Smoliak, Personal comm.). This is a minor type and somewhat rare in soil correlation area 1. Silver sagebrush cover was low at 2 % canopy cover but shrubs heights were among the tallest in the study (.5 to .75 m) area. Note that total vegetation cover was high at 96% and only a trace of bare soil was evident.

Soil Exposure: 0.25% **Moss/Lichen Cover:** 69% **Total Vegetation:** 96%

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
SILVER SAGEBRUSH *(Artemisia cana)*	2	2	100
FORBS			
FRINGED SAGEWORT *(Artemisia frigida)*	1	1	100
SHINING ARNICA *(Arnica fulgens)*	1	1	100
COMMON YARROW *(Achillea millefolium)*	0	0	100
GRASSES			
WESTERN PORCUPINE GRASS *(Stipa comata)*	21	21	100
UNDIFFERENTIATED SEDGE *(Carex)*	8	8	100
NEEDLE ANDTHREAD *(Stipa comata)*	5	5	100
WESTERN WHEATGRASS *(Agropyron smithii)*	4	4	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	2	2	100
BLUE GRAMA GRASS *(Bouteloua gracilis)*	1	1	100
PLAINS REED GRASS *(Calamagrostis montanensis)*	0	0	100
SANDBERG'S BLUE GRASS *(Poa sandbergii)*	0	0	100

ENVIRONMENTAL VARIABLES

RANGE SITE
OVERFLOW (NON-SALINE)

SOILS
DARK BROWN CHERNOZEMS(?)

ELEVATION:
850-975 M

SOIL DRAINAGE:
IMPERFECTLY DRAINED

SLOPE :
2-3%

ASPECT:
NORTH

FORAGE PRODUCTION (LB/AC)

GRASS	NOT AVAILABLE
FORB	NOT AVAILABLE
SHRUB	NOT AVAILABLE
LITTER	1450
TOTAL	NOT AVAILABLE

Suggested Grazing Capacity
48-60 Ac/AU

COMMUNITY TYPE 4

Silver Sagebrush/Western and Northern Wheatgrass

(Artemisia cana - Agropyron smithii and dasystachyum) Shrub herbaceous

n=2 This is a drier upland expression of the riparian type described by Thompson and Hansen (2002) which is found on older alluvial terraces on both broad and narrow flood plains and coalescing alluvial fans in valleys within the Dry Mixed Grass and soil correlation area 1. Plant species composition can be very similar in the two variants but the riparian type produces taller shrubs (.75 to 1.5 m vs. .2 to .35 m), has much higher shrub canopy levels (39% vs 11%) and has greater soil exposure due to higher levels of sediment movement. For this type, western and northern wheatgrass are well adapted to re-colonizing disturbed overflow sites, given their rhizomatous root systems, with sediment additions or due to grazing impacts. Though there is limited information about Silver Sagebrush plant communities most sources agree that it provides an important structural layer with opportunities for food and shelter for many wildlife species.

Soil Exposure: 26%(4-48) **Moss/Lichen Cover:** 42%(0-83) **Total Vegetation:** 66%(51-81)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SILVER SAGEBRUSH *(Artemisia cana)*	11	5-18	100
RABBITBRUSH *(Chrysothamnus nauseosus)*	3	0-7	50
FORBS			
FRINGED SAGEWORT *(Artemisia frigida)*	1	0-3	50
COMMON YARROW *(Achillea millefolium)*	0	0-0	50
SCARLET MALLOW *(Sphaeralcea coccinea)*	0	0-0	50
GRASSES			
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	15	5-24	100
WESTERN WHEATGRASS *(Agropyron smithii)*	15	0-31	50
GREEN NEEDLE GRASS *(Stipa viridula)*	4	0-8	50
JUNE GRASS *(Koelaria macrantha)*	2	1-3	100
PLAINS REED GRASS *(Calamagrostis montanensis)*	0	0-0	50
UNDIFFERENTIATED SEDGE *(Carex spp.)*	0	0-0	50

ENVIRONMENTAL VARIABLES

RANGE SITE
OVERFLOW (SODIC/SALINE)

SOILS
ORTHIC REGOSOLS (ORION)

ELEVATION:
850-975 M

SOIL DRAINAGE:
MODERATELY WELL DRAINED

SLOPE :
LEVEL
NEARLY LEVEL

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
TOTAL
LITTER 400-500

Suggested Grazing Capacity
60-80 Ac/AU

COMMUNITY TYPE 5

Silver Sagebrush/Northern Wheatgrass - Blue Grama Grass

(Artemisia cana/Agropyron dasystachyum - Bouteloua gracilis) Herbaceous shrub

n=10 This community type is the late seral to reference plant community on moderately well drained to imperfectly drained solonetzic soils of loam to clay loam texture, termed **blowout** range sites with characteristic eroded pits in the soil surface. This is similar to the Bouteloua-Agropyron community described by Coupland (1950, 1961) a product of the special character of blowout conditions. Parent materials are developed from lacustrine material or glacial till, both of which may be rich in marine shales. Needle-and-thread grass, normally dominant in most Dry Mixed Grass plant communities, is not well suited to the impermeable subsoils, where Northern and Western wheatgrass are more successful (Weaver 1942, Coupland 1961). Productivity data summarized below is the average of 12 years at Cressday and Sage Creek rangeland reference sites. This community type, given soil limitations, is significantly less productive than the Silver Sagebrush/Needle-and-Thread -Blue grama type. Heavy grazing pressure will significantly diminish vegetation canopy cover. Grazing resistant species like Sandberg bluegrass will increase in abundance while canopy cover and composition of Northern and Western wheatgrass will decline. Conservative stocking rates are normally recommended for this type given the especially dry growing conditions imposed by the hardpan character of the surface soil.

Soil Exposure: 24% (4-42) **Moss/Lichen Cover:** 55% (5-88) **Total Vegetation:**45% (34-73)

PLANT COMPOSITION

	CANOPY COVER(%)		
	MEAN	RANGE	CONST
SHRUBS			
SILVER SAGEBRUSH *(Artemisia cana)*	3	0-12	60
FORBS			
NUTTALL'S ATRIPLEX *(Atriplex nutallii)*	1	0-4	57
FRINGED SAGEWORT *(Artemisia frigida)*	0	0-1	71
PRICKLY PEAR CACTUS *(Opuntia polyacantha)*	1	0-3	29
GRASSES			
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	9	2-32	100
BLUE GRAMA GRASS *(Bouteloua gracilis)*	3	0-11	100
JUNE GRASS *(Koeleria macrantha)*	2	0-6	80
NEEDLE AND THREAD *(Stipa comata)*	2	0-5	80
UNDIFFERENTIATED SEDGE *(Carex)*	1	0-4	80
SANDBERG'S BLUEGRASS *(Poa sandbergii)*	1	0-3	71
BLUEGRASS *(Poa spp.)*	0	0-2	29
MAT MUHLY *(Muhlenbergia richardsoni)*	0	0-3	14

ENVIRONMENTAL VARIABLES

RANGE SITE
- BLOWOUT

SOILS:
- BROWN SOLONETZ(BULLPOUND)
- BROWN SOLODIZED SOLONETZ(WARDLOW, DUCHESS, HEMARUKA, STEVEVILLE)
- BROWN SOLOD(KARLSBAD, GEM, HALLIDAY)

ELEVATION:
- 850-975 M

SOIL DRAINAGE:
- MODERATELY WELL DRAINED
- IMPERFECTLY DRAINED

SLOPE :
- LEVEL TO GENTLE

ASPECT:
- VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS	347 (187-551)
FORB	114 (27-231)
TOTAL	461
LITTER	250(100-400)

Suggested Grazing Capacity
90-140 Ac/AU

COMMUNITY TYPE 6

Silver Sagebrush/Needle and Thread - Blue Grama

(Artemisia cana/Stipa comata - Bouteloua gracilis) Herbaceous shrub

n=8 This is the dominant plant community on well drained Brown Chernozemic soils and moderately well drained Solonetzic Brown Chernozems and is closely linked to the Stipa-Bouteloua faciation described by Coupland (1961). This type is considered the late seral to reference plant community for these soils given the dominance of mid-grasses like Needle-and-Thread and Northern wheatgrass. Coupland (1961) challenged the interpretation of previous studies (Clark et al. 1942, Hubbard 1950) that described this as a Bouteloua- Stipa community implying a "short grass" prairie designation. Coupland (1961) concluded that the loamy soils in the brown soil zone would normally support mixed grass communities. Early studies were likely carried out after decades of heavy grazing had reduced the prominence of midgrasses. Coupland observed the prairie decades later when midgrass vegetation was beginning to reestablish dominance. In terms of grazing management, heavy grazing pressure will first lead to a decline in wheatgrass cover and eventually needle-and-thread will be replaced by more grazing resistant speceis like blue grama, Sandberg bluegrass and sedges. This upland type has the lowest cover of silver sagebrush at about 2% canopy cover. This type is similar to the Stipa comata - Bouteloua gracilis community described by Coupland (1961) but distinguished by the presence of silver sagebrush. Forage production data presented below is 12 year average from the Murray Lake rangeland reference area located on Maleb soil series: Orthic Brown Chernozems.

Soil Exposure: 13% (0-43) **Moss/Lichen Cover:** 51% (12-78) **Total Vegetation:** 62% (46-86)

PLANT COMPOSITION

	CANOPY COVER(%) MEAN	RANGE	CONST
SHRUBS			
SILVER SAGEBRUSH *(Artemisia cana)*	3	.2-9	100
FORBS			
FRINGED SAGEWORT *(Artemisia frigida)*	2	0-5	80
SCARLET MALLOW *(Sphaeralcea coccinea)*	0	0-1	80
WINTER FAT *(Eurotia lanata)*	0	0-2	40
GRASSES			
NEEDLE ANDTHREAD *(Stipa comata)*	10	2-32	100
NORTHERN WHEATGRASS *(Agropyron dasystachyum)*	6	0-15	88
BLUE GRAMA GRASS *(Bouteloua gracilis)*	5	1-9	100
UNDIFFERENTIATED SEDGE *(Carex)*	3	1-6	100
JUNE GRASS *(Koeleria macrantha)*	2	0-5	100
SANDBERG'S BLUEGRASS *(Poa sandbergii)*	2	0-8	80
PLAINS REED GRASS *(Calamagrostis montanensis)*	1	0-2	60
WESTERN WHEATGRASS *(Agropyron smithii)*	1	0-2	40

ENVIRONMENTAL VARIABLES

RANGE SITE
LOAMY

SOILS
SOLONETZIC BROWN CHERNOZEM (CHINZ, RONALAINE, TILLEY)
ORTHIC BROWN CHERNOZEM (BUNTON, CRANFORD, CHIN, MALEB, MASINASIN)

ELEVATION:
850-975 M

SOIL DRAINAGE:
WELL TO MODERATELY WELL DRAINED

SLOPE :
LEVEL TO GENTLE

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS 460 (43 - 874)
FORB 42 (3- 118)
TOTAL 502
LITTER 356(100-450)

Suggested Grazing Capacity
60-80 Ac/AU

COMMUNITY TYPE 7

Creeping Juniper - Sedge

(Juniperus horizontalis - Carex) Herbaceous

n=2 This is a very unique plant community within the Many berries Badlands and is utilized as nesting habitat by Sage-Grouse within the overall silver sagebrush landscape of southeastern Alberta. The plant community is established on a badland range site, with more than 10 % bedrock exposure. The unique soil conditions where creeping juniper establishes is formed on slump materials of Bearpaw shales that accumulate on mid to lower slope positions and then are subject to wind and water erosion (McNeil, personal comm.). The clay soil peds are easily moved by wind and water. There appears to be enough moisture provided from winter snow trapping and from spring and summer overflow to support creeping juniper, that no other species are able to out compete. While the sites are barren in character, creeping juniper provides valuable vertical structure on the site.

Soil Exposure: 87 % (79-95) **Moss/Lichen Cover:** 3 % (1-5) **Total Vegetation:** 17% (10-25%)

PLANT COMPOSITION CANOPY COVER(%)

	MEAN	RANGE	CONST
SHRUBS			
CREEPING JUNIPER *(Juniperus horizontalis)*	7	2-11	100
COMMON WILD ROSE *(Rosa woodsii)*	1	0-2	50
FORBS			
GOLDEN BEAN *(Thermopsis rhombifolia)*	1	1-2	100
YELLOW UMBRELLA PLANT *(Eriogonum flavum)*	1	1-2	100
GRASSES			
UNDIFFERENTIATED SEDGE *(Carex)*	2	0-4	100
SAND GRASS *(Calamovilfa longifolia)*	1	0-1	100
WESTERN WHEAT GRASS *(Agropyron smithii)*	1	0-1	100

ENVIRONMENTAL VARIABLES

RANGE SITE
SALINE LOWLAND

ELEVATION (M):
1026 (1016-1035)

SOILS:
ORTHIC REGOSOL (ZER)

SOIL DRAINAGE:
WELL DRAINED

SLOPE:
MODERATE
STRONG

ASPECT:
VARIABLE

FORAGE PRODUCTION (LB/AC)

GRASS NOT AVAILABLE
FORB NOT AVAILABLE
SHRUB NOT AVAILABLE
LITTER NOT AVAILABLE
TOTAL NOT AVAILABLE

Suggested Grazing Capacity
Nil Ac/AU

3.9 *Photographs - Silver Sagebrush Plant Communities in the Sage-Grouse Home Range Area of Southeastern Alberta.*

Photo 5. Silver Sagebrush/Wheatgrass - Nuttall's Atriplex *(Artemisia cana/Agropyron spp. - Atriplex nuttallii)* Shrub herbaceous **Saline Lowland**

Photo 6. Silver Sagebrush/ Undifferentiated Wheatgrass *(Artemisia cana / Agropyron spp.)Herbaceous shrub* **Saline Lowland**

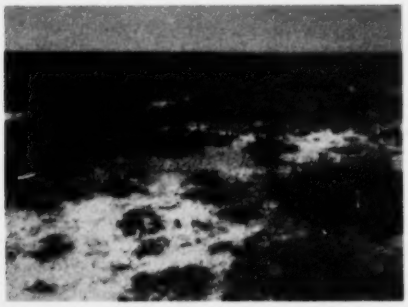

Photo 7. Silver Sagebrush/Northern Wheatgrass - Blue Grama Grass *(Artemisia cana/Agropyron dasystachyum - Bouteloua gracilis)* Herbaceous shrub **Blowout**

Photo 8. Silver Sagebrush/Needle and Thread - Blue Grama *(Artemisia cana/Stipa comata - Bouteloua gracilis)* Herbaceous shrub **Loamy**

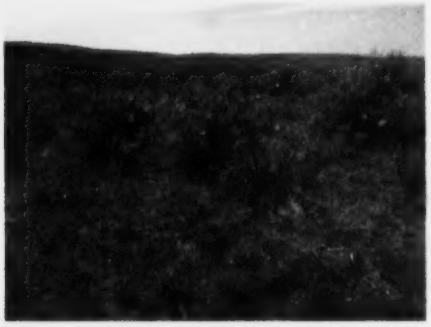

Photo 9. Silver Sagebrush/ Western and Northern Wheatgrass *(Artemisia cana/ Agropyron smithii and dasystachyum)* Shrub herbaceous **Overflow (saline)**

Photo 10. Silver Sagebrush/Western Porcupine Grass - Sedge *(Atrimisia cana/Stipa Curtiseta - Carex spp.)* Herbaceous shrub **Overflow (non-saline)**

4.0 Role of Fire in Silver Sagebrush Ecology

4.1 Fire History

Prior to European settlement of the prairie region, fire was part of the prevailing climate. Sagebrush communities would have been influenced by periodic fires of variable frequency and intensity in southeastern Alberta. While exact nature of the pre-settlement fire regime is poorly defined (Bradley and Wallis 1996), several factors were likely involved in determining fire impact, especially at local or site-specific scales. Such variables include wet and dry cycles, the amount of residual cover (litter), the quantity of dead and standing grasses and forbs, and the health and vigor of shrub communities, primarily those dominated by Silver Sagebrush (*Artemisia cana*). Grazing intensity, especially that of bison (*Bison bison),* can mimic fire in the removal of plant biomass (Bradley and Wallis 1996) and the accumulation of litter and hence would also have been a contributing factor to the fire history of the area.

Adequate fuel loads would likely have been created when several consecutive wet years promoted an abundance of grasses and forbs, combined with light grazing to provide high amounts of litter. Furthermore, dry periods could have created fire conditions severe enough to carry a fire through sagebrush communities with the intensity to kill and severely damage the shrub overstory. Silver sagebrush would respond by regenerating from vegetative sprouts (Tisdale and Hironka 1981). Recovery to mature stands would proceed in time relative to subsequent moisture conditions and grazing pressure. In big sage brush environments, a natural fire interval is projected at 30-50 years, the time required for re-establishment of sagebrush to pre-fire conditions (Tisdale and Hironka 1981, Braun 1987).

Prairie fires often had devastating impacts on early settlers. In 1877 the council of the North West Territories, passed an ordinance for the prevention of forest and prairie fires at its first session (Murphy 1985). The occurrence of natural fire following settlement of the region, especially after the homesteading activity of 1900-1910, is uncertain but it is likely fires were either prevented or controlled whenever possible (Bradley and Wallis 1996). Certainly fire as an ecological force on the landscape ended during 1910-1935 which was a period of extensive and heavy grazing in the area by domestic livestock.

4.2 Impact of Fire on Native Vegetation

In Alberta, research shows that in pre-settlement times, fire was one of a number of landscape processes including periodic drought and grazing that tended to limit the establishment and maintenance of woody species on the landscape (Johnston and Smoliak 1968). Presumably, the abundance of sagebrush in the prairie environment followed the normal cycles of grazing, wildfire and drought.

The role of fire in the health, vigor, age, density and distribution of Silver Sagebrush is of special interest given its importance to Sage-Grouse and other wildlife species in the dry mixed prairie region. Little information is available defining fire impacts on silver sagebrush. Light spring burning of silver sagebrush can encourage resprouting and an increase the production of new

Photo 11 A prairie wildfire in the dry mixed grass prairie in 1900 (Glenbow Museum).

vegetative shoots (Wambolt et al. 1990). Fall burning appears to have the opposite effect, reducing shrub cover and regeneration and favoring grass and forb cover the following spring (Wambolt et al. 1990).

4.3 Fire Ecology and Sage-Grouse

Unlike other species of prairie grouse, Sage-Grouse do not require a patchy distribution of multi-species vegetation with abundant edge, a situation often created by burning in Big sagebrush landscapes. In Alberta and Saskatchewan Sage-Grouse are directly dependent on Silver Sagebrush throughout their life cycle, an association with sagebrush so interlinked that it limits their range throughout North America (Aldrich 1963). Optimal habitat for Sage-Grouse in areas where the species is non-migratory is a mixture of sagebrush densities and heights sufficient to meet all travel, breeding, nesting, feeding and cover requirements in "well-integrated seasonal habitats" (Connelly et al. 2000) that reduce daily and seasonal movements and the risk of predation. Sage-Grouse in Alberta are non-migratory (Herzog 1987, Aldridge 1998) but seasonal movements of 10 to 20 km one-way between or among seasonal habitat types is common.

Information on the impact of fire in silver sagebrush/Sage-Grouse habitats is lacking (Connelly et al. 2000) and this constitutes an important information gap. Neither of the approaches to fire documented by Wambolt et al. (1990) would appear to benefit Sage-Grouse in the short term: spring burning would eliminate important nesting habitats and cause the abandonment of leks and fall burning would remove critical wintering habitat (Connelly et al. 2000).

However, the effects of fire on Sage-Grouse population levels and habitat use have been studied in Big sagebrush *(Artemisia tridentata)* communities. Wildfires and prescribed burning can dramatically impact Big sagebrush because unlike Silver Sagebrush, this shrub does not resprout after fire but relies on seed production for propagation of new plants (Tisdale and Hironka 1981). Indeed burning has been a tool used by land managers to permanently eliminate Big sagebrush and establish grassland as the dominant community.

Controlled burns for restoration of wildlife habitat are typically undertaken in dense stands of homogenous old-age Big sagebrush where coverage exceeds 30-40% of the canopy. The goal is to create mosaics of sagebrush of different age and structure with generally light coverage (15-20%) to provide for a variety of the seasonal habitat requirements of Sage-Grouse. Unfortunately, fire has negatively affected breeding habitats causing population declines of up to 80% (Connelly et al. 1994, 2000), the loss of leks (Hulet 1983) and the removal of nesting habitat for at least 14 years post-burn (Nelle et al. 2000). Prescribed burning may improve the potential of sagebrush habitat for brood-rearing if important forbs and insects used for food increase in abundance (Nelle et al. 2000). However, increases in these food items are unpredictable. Canopy cover of sagebrush must be reduced to 0-12% which increases the risk of predation, especially if accessibility to escape cover (40% canopy cover) is limited near feeding areas (Connelly et al. 2000). Winter habitats can also be negatively impacted by burning. Sage-Grouse in Idaho were forced to move up to 10 km to unburned sites after fire (Robertson et al. 1991).

4.4 Fire as Threat to Population Recovery of Sage-Grouse in Alberta

Silver Sagebrush is a shrub of moderate height, structure and density and creates a habitat for Sage-Grouse lower in quality and carrying capacity when compared to Big sagebrush. With the exception of riparian corridors and outwash plains, the density, canopy coverage and height of Silver Sagebrush rarely meets the minimum habitat guidelines recommended for Sage-Grouse by Connelly et al. (2000). Further reduction in these important habitat characteristics through the use of fire, even during the short-term, might readily remove critical habitat for Sage-Grouse.

In the pre-settlement era, local population levels of Sage-Grouse were adapted to high degrees of environmental uncertainty, a typical response for a species at the extreme limits of its distribution (Smith and Smith 2000). Habitat disturbances and limiting factors unique to the area (e.g. the late phenology of forbs needed to enrich the diet of laying and nesting Sage-Grouse) dramatically controlled population growth and survival. Declines in local populations were offset by higher survival and recruitment in associated populations allowing Sage-Grouse to persist in the region. Populations also remained resilient, as "source" populations of Sage-Grouse were able to colonize vacant habitat.

The present range of Sage-Grouse in Alberta has contracted to 4,000 sq km, only 1/10 of its historical distribution of 40,000 sq km, thereby eliminating the historic pool of source populations in the province. Neither are source populations of Sage-Grouse available in Montana where habitat corridors have been lost south of the 49th parallel (A. Rosengaard, pers.comm.). Furthermore, since a breeding population of Sage-Grouse is defined as a "group of birds associated with one or more leks in the same geographic area separated from other leks by greater than 20 km" (Connelly et al. 2000), there are only one or two breeding populations left in Alberta; one southeast of Manyberries and the other at Wildhorse. These populations are estimated to be less than 400 birds (Nicholson (2002) Personal Comm.) and occupy a restricted area (125 sq km) of non-contiguous habitat, within a fragmented landscape. Grouse populations inhabiting fringe habitats often fluctuate dramatically in response to environmental factors and habitat disturbances. At this time, wild or prescribed fire in silver sagebrush habitats is expected to increase risks to Sage-Grouse habitat quality and availability. Clearly, much more

information is required about fire impacts on Silver Sagebrush, before it can be recommended as a tool for habitat enhancement.

4.5 Summary

The role of fire in silver sagebrush communities is poorly understood. Historically, drought, heavy grazing and fire would likely have reduced the cover of woody species on the prairie landscape. Silver sagebrush persisted in overflow sites and micro-sites with superior moisture. Variable periods of rest from grazing, combined with improved moisture levels, would have allowed shrub regeneration and for silver sagebrush communities to persist.

A single study in Montana indicates that spring burning may foster silver sagebrush regeneration while fall burning may lead to declines. Spring burning treatments from either wild or prescribed burns, may place unacceptable levels of risk on the remnant population of Sage-Grouse.

There is insufficient information at this time to recommend the use of fire as a restoration tool for silver sagebrush. Further study of this landscape process is required. Prescribed fire trials could be undertaken in sagebrush stands not currently occupied by Sage-Grouse. Field studies should examine the effect of prescribed fire on silver sagebrush stand regeneration, the re-establishment of canopy cover and stand structure, vigor and canopy characteristics.

5.0 Grazing Management and Sage-Grouse

5.1 Review of the Literature

5.1.1 Introduction

Land managers must be able to define beneficial management practices for Sage-Grouse before they can recommend adaptative strategies to ranchers. While the exact reasons for the serious decline in Sage-Grouse populations remain unclear (Crawford et al. 2004), it is incumbent on each land use activity on the prairie landscape to define management practices to minimize further stresses to the species. The presence of ranching as a long-term and sustainable land use activity serves to preserve the basic habitat that is required by Sage-Grouse to survive. Currently, there is little information available pertaining to grazing management and Sage-Grouse in the Canadian prairies. Most of the available literature deals with grazing practices on US landscapes with different species of Sagebrush as well as climate and soils. In this section a preliminary description of beneficial management practices will be developed for Sage-Grouse based on the available literature and difference in Sage-Grouse biology and Silver Sagebrush ecology in contrast to the US situation.

Habitat requirements and life cycle characteristics of Alberta Sage-Grouse have been described recently by Aldridge (2002) and Alberta (2002). The literature stresses the importance of:

- viable sagebrush communities,
- adequate plant cover to conceal Sage-Grouse nests, adults and young,
- forage supply for hens and young, especially succulent forbs, and
- winter cover.

Grazing impacts on Sage-Grouse may be positive, negative or neutral.

5.1.2 Grazing Impacts on Sagebrush

Much of the Sage-Grouse literature deals with habitats in the United States where big sagebrush (*Artemisia tridentata* subspecies *tridentata)* is the dominant shrub species. Big sagebrush appears to be an increaser species that has expanded on the landscape in response to historical heavy grazing practices. Big sagebrush can both displace herbaceous vegetation and produce an excessive shrub canopy relative to Sage-Grouse needs. Mature big sagebrush stands tend to lack a sufficient matrix of herbaceous material to support Sage-Grouse foraging requirements. Heavy grazing can lead to an expansion in big sagebrush shrub canopy cover as the shrub acts as an increaser[6] due grazing pressure. Managed grazing can be used in a prescriptive way create more patchiness within otherwise continuous sage canopies (Beck and Mitchell 2000).

The grazing response of silver sagebrush seems much different from that of big sagebrush. Silver sagebrush does not establish the same height or cover characteristics as big sagebrush and occupies a lesser prominence on Alberta Sage-Grouse ranges. It also appears that silver

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[6] As grazing pressure progresses from light to moderate to heavy, an increaser plant species will increase in relative abundance.

sagebrush behaves more like a decreaser[7] species in response to grazing, trampling and drought, although it has a strong potential to resprout and regenerate in favorable periods of moisture and rest. Being lower in stature, silver sagebrush is likely more vulnerable to trampling by livestock, especially vegetative sprouts and juvenile plants. Trampling may be the principal cause of silver sagebrush decline on livestock wintering sites. The literature stresses the need to evaluate grazing impacts from all grazers. Future research should identify potential impacts on silver sagebrush of both livestock and ungulates like antelope.

5.1.3 Grazing Impacts on Cover and Forage Availability

Grazing intensity, normally a function of stocking rate, tends to be the chief management factor affecting the amount of residual plant material that is left ungrazed on a range site (Holechek et al. 1998). Adequate plant residue or litter is an important factor in rangeland health (Adams et al. 2003). Litter contributes to site stability by enhancing moisture infiltration into the soil and helping reduce moisture loss from the plant canopy by cooling and shading the soil. The literature stresses that adequate litter cover is required to conceal Sage-Grouse nests and young from predators and that grazing intensity affects residual cover (Van Poolen and Lacy, 1979).

Call and Maser (1985) suggest that managers need to protect at least 50% of annual production to provide adequate litter cover and that Sage-Grouse winter ranges should be even more lightly grazed. First and foremost, grazing impacts need to be viewed in the context of current grazing management. Evans (1983) reported a significant increase in Sage-Grouse production when grazing intensity was reduced from heavy to moderate and again from moderate to light. During drought, the normal range management precautions for reduced stocking and extra rest are essential to maintain adequate litter levels for subsequent recovery.

The current published stocking rate for blowout range sites (Wroe et al. 1988) in the study area is 80 acres per AUY (.15 AUM/acre). The working recommendation currently employed by Public Lands and Forests Division for the study area (as described in Chapter 1) ranges from 80 to 120 acres per AUY (.15 to .1 AUM/acre). Based on local forage production values on blowout range sites, these stocking rates would result in average utilization rates of about 25 to 40% of current annual production[8] and grazing intensity would be considered light to light-moderate.

There is likely an important interaction between shrub canopy and grazing intensity. Preliminary results from a grazing trial in Colorado (France 2004, Personal Comm.) show that at light to moderate levels of grazing utilization, grazing of big sagebrush under-canopy was negligible.

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[7] As grazing pressure progresses from light to moderate to heavy, a decreaser plant species will decline in abundance.

[8] Assumptions: Stocking rates at .1 to .15 AUM/acre implies forage harvest levels of about 100 to 150 lb./ac. Long-term forage production on grazed range sites for the two lowest producing soil types in the study area are 389 lb./ac. at Sage Creek and 355 lb./ac. at Cressday. The average for the two sites combined is 372 lb./ac. suggesting a general utilization rate of 26 to 40 % of current annual production based on the grass component alone (Moisey and Adams 2003).

Grazing of shrub under-canopies would likely occur at higher levels of grazing intensity, when cattle are forced to use the less accessible forage.

After grazing intensity, timing and duration of grazing likely rank second in importance in the maintenance of herbaceous cover for Sage-Grouse. Consistent early spring use of a given pasture unit will reduce plant vigor and productivity and increase the potential of competition for forage between livestock and young birds. Potential for competition with Sage-Grouse young may be in proportion to the extent to which cattle select mesic/moist sites that are preferred foraging areas. Young birds seek out insects and succulent forbs in these habitats (Aldridge 2002, Young 1994, Paige and Ritter 1999).

Grazing during the late spring nesting period can reduce herbaceous cover necessary for concealing nests from predators (Beck and Mitchell 2000). Heavy grazing reduces cover and increases the chance of predation, especially by ground squirrels (*Spermophilus spp.*)(Braun 1987). During drought conditions, important forage plants may be grazed earlier than normal, thus reducing the potential forage supply for young birds. Conversely, dormant season grazing of brood rearing areas will reduce potential for overlap with Sage-Grouse diets.

5.1.4 Nest Trampling

Early spring grazing may also affect nest trampling but opinions differ on this in the literature. Nest abandonment was most strongly associated with sheep since the density of stocking would be about 4 to 5 times higher based on grazing equivalency. Paine et al. (1996) reported heavy nest impacts in a simulation study for song birds but the stocking rates were based on intensive rotational grazing systems such as those that would be used in Wisconsin, the results having questionable relevance to the extensive range pasture systems found in southeastern Alberta. The greatest potential for nest impacts on Sage-Grouse may be associated with forced livestock movements across a nesting areas (Autenrieth 1981). Call and Maser (1985) and Aldridge (Personal comm.) suggest that so long as key vegetation components do not deteriorate, cattle are not a serious factor in destruction of nests.

5.1.5 Moist/Mesic Environments

Management impacts on rangeland hydrology and mesic/moist foraging sites may be very important to consider in the scope of the Sage-Grouse research. The literature stresses the value of these habitats to Sage-Grouse that have a limited area in the dry prairie environment. Livestock producers are becoming aware of the impact that grazing can have on riparian environments (Fitch and Adams 1998). Certain grazing practices can degrade range sites that are termed overflow, swale or gully environments, resulting in lowered water tables and a drying out of the growing environment (Adams and Fitch 1995, Klebenow 1982). Reduced water volumes, poorer water spreading and reduced retention on overflow sites would likely reduce the productivity of vegetation including that of succulent forb species that are vital forage to young Sage-Grouse (Aldridge 2002). A variety of grazing management options have been described to restore and maintain vegetation in riparian environments (Adams and Fitch 1995).

Concerns have been raised about the condition and productivity of moist/mesic environments given the findings of McNeil and Sawyer (2003). The study concluded that sagebrush habitats

may have been compromised by the low number of precipitation events between 1978 and 1995 and by the dramatic increase in drainage impediments since 1951.

5.1.6 Positive Impacts

A number of sources (Neel 1980, Klebenow 1982, Evans 1986) suggest that appropriate grazing management can be used to stimulate the productivity of forbs important as Sage-Grouse food. This will be particularly important on rangelands with a history of light grazing where forb cover has become reduced by graminoid competition, a common feature of dry mixed grass prairie plant communities. Grazing tends to delay maturation of forbs, especially common dandelion and yarrow. Forbs become available throughout the summer, and regrowth is higher in crude protein and lower in crude fibre (Evans 1983 in Madsen 1995). Kerwin (1971) identified a number of forb species both native and introduced as being important in sage grouse diets including common yarrow *(Achillea millefolium)*, small-leaved everlasting *(Antennaria* spp.*)*, pasture sagewort *(Artemisia frigida)*, milk vetch *(Astragalus* spp.*)*, fleabane *(Erigeron* spp.*)*, common blue lettuce *(Lactuca pulchella)*, common pepper-grass *(Lepidium densiflorum)*, alfalfa *(Medicago sativa)*, clovers (*Melilotus* spp.), moss phlox *(Phlox hoodii.)*, plantain (*Plantago* spp.*)*, perennial sow-thistle *(Sonchus arvensis)*, common dandelion *(Taraxacum officinale)* and common goat's-beard *(Tragopogon dubius)*.

A recent study at Grasslands National Park examined differences between grazed and protected sites for sagebrush-dominated vegetation on alluvial landforms (Thorpe and Godwin 2003). Comparisons were made at five sites between moderately grazed and areas protected from grazing for 7 to 17 years. While only modest differences in horizontal cover of various vegetation layers were observed the richness of forb species at the local level was significantly lower in ungrazed areas. The authors suggest that a mosaic of heavily and lightly impacted areas are needed to provide the best habitat. Patchy cover would enhance the supply of forb species for Sage-Grouse to forage on.

5.1.7 Grazing Management Priorities for Sage-Grouse

In summary, the literature suggests the following priorities for harmonizing grazing management with the needs of Sage-Grouse:

- Evaluate past management practices and management needs on a ranch specific basis before recommending grazing management strategies to improve Sage-Grouse habitat.
- Protect silver sagebrush landscapes in southeastern Alberta to safeguard habitat for breeding, nesting, brood-rearing and wintering needs of Sage-Grouse.
- Encourage practices that increase height and cover of sagebrush and of native grasses at nesting sites.
- Maintain light grazing intensities to produce mosaics in vegetation and an increase in herbage production that are favorable for Sage-Grouse nesting and brood-rearing habitat.

- Patchy grazing will increase the availability of forbs and stimulate their growth in upland meadows.

- Practice grazing deferral to allow for undisturbed nesting.

- Grazing deferral may also prevent competition for forage, especially lush forbs required by young Sage-Grouse.

- Practices that increase the amount of rest in a pasture may be a useful to restore fair and poor condition range which will provide more cover for Sage-Grouse.

- Riparian area management practices are required to maintain only light to moderate grazing pressure on mesic meadows and riparian areas.

5.2 Preliminary Beneficial Grazing Management Practices for Sage-Grouse

5.2.1 Grazing Intensity and Stocking Rates

The application of correct stocking rates influences grazing intensity and is the most important of range management decisions (Holechek et al. 1998). Grazing intensity affects the relative amount of forage biomass that is removed by grazing versus the amount of residual cover left behind for wildlife and insects and eventually subject to weathering processes. Grazing intensity will determine the amount of biomass that remains as protective cover and forage for Sage-Grouse.

Though there is an array of techniques for determining proper stocking rates, there is no substitute for experience over prolonged time periods and variable climatic conditions. In Alberta, stocking rates are normally expressed as the amount of land allocated to each animal unit (Animal Unit Months/acre or Acres / Animal Unit Year). Grazing capacity is generally considered to be the average number of animals that a particular range will sustain over time (Holechek et al. 1998) while maintaining range condition (now termed range health in Alberta). Proper stocking rates are normally established to achieve a number of basic range conservation objectives including:

- maintain late seal to near climax vegetation to optimize forage production and stability of the forage production system,

- maintain adequate residual carryover that will eventually form litter; litter is an insulating mulch that enhances moisture retention and protects range soils from accelerated erosion and also protects watershed values,

- maintain cover, food and community structure for wildlife species.

Though our perception of the character of the pre-European prairie is largely conjecture, none-the-less we need to understand long-term ecosystem status and processes as best we can before adaptive management practices can be applied (Kay 1996). A prevailing paradigm guiding the integration of prairie wildlife species with livestock grazing practices is the concept of the "range of natural variation" (Bradley and Wallis 1996; Prescott et al. 1994; Dale and Prescott

Figure 5 Observation of bird and mammal species on the prairie indicate that they evolved and adapted to variation in grazing intensity and timing. Most are adapted to moderate grazing while a number of species require light and heavy grazing rates.

2000). Observation of bird and mammal species on the prairie today suggests that wildlife species evolved with a range in natural variation of grazing intensity and timing of grazing. The distribution of wildlife species suggests that moderate grazing was most frequent with a lower frequency of light and heavy grazed areas (Figure 5). Wildlife preferences seem to correspond to these grazing levels with most species favoring moderate levels, but other species having definite requirements for both lightly and heavily grazed prairie. The science of ecosystem management holds that grazing systems will allow the creation of planned heterogeneity through controlling the timing, intensity of grazing and rest periods (Bradley and Wallis 1996). A good example of this is the management plan developed for the Milk River Natural Area (Hood and Gould 1982). Grazing is tailored to promote an interspersion of heavily and very lightly grazed patches. The management plan aims to achieve this with light stocking rates, deferred entry of grazing each year until June 15, and season-long continuous grazing to reinforce a selective grazing pattern by livestock. Stocking rates are light at 100 ac/head.

Beneficial Practices - Grazing Intensity

In terms of the overall range landscape, Sage-Grouse prefer the lightly grazed range of the grazing intensity spectrum. They require more abundant organic residue in the form of litter, therefore the desired grazing intensity would be described as light-moderate to light. In terms of

patch diversity, the literature also suggests that Sage-Grouse will likely benefit from a patchy cover of late seral plant communities to stimulate forb production. Key considerations:

- Grazing intensity can be evaluated indirectly for a ranch, grazing lease or pasture unit by comparing grazing utilization records with recommended stocking rates.

- Grazing intensity can also be evaluated through range health measurements and range litter standards. Light grazing intensity would be defined by a percentage utilization of current production at between 20 - 35 % of forage production (Hoechek 1998). Range health parameters (Adams et al. 2003) can be used to evaluate grazing intensity. Plant residue in the form of litter can be evaluated in relation to litter standards for the appropriate ecological site. Low range health scores, with reduced scores for plant community ecological status, structure, litter residue and increased bare soil would serve as a coarse filter tool for identifying sites where grazing intensity has been moderate-heavy, heavy and very heavy.

- In the case of low range health scores, reduced stocking levels would be required to achieve lighter intensity.

- The impacts of all grazers domestic and native need to be considered when establishing appropriate stocking rates.

5.2.2 Onset of Grazing

A key principle of range management is to avoid grazing range during vulnerable growth phases especially during early spring (Adams et al. 1991). The traditional consideration for onset of grazing from a plant physiology perspective has been that of plant energy levels. For most native perennials, energy reserves are at their lowest as plants emerge from winter dormancy and begin to establish new leaf material. Grazing during early spring will put additional stress on range plants when energy levels are already low. Willms (Personal comm.) suggests another mechanism, that the negative impacts of spring grazing has more to do with the removal of litter resulting in a drying effect on the plant community and that the energy reserves concept pertains where grazing is early, heavy and continuous.

Whatever the cause, early-spring grazing has negative impacts on productivity. Ranchers compensate for this through the practice of deferral, which means to delay grazing until a critical growth stage of the plant is passed (e.g. flowering, seed ripe, maturity). Deferral is intended to permit seed production, seedling establishment and restoration of plant vigor. Deferral, along with moderate rates of stocking, promotes the full growth potential of range vegetation. A general rule-of-thumb is that 1 day of spring deferral may allow 2 days of grazing later in the season.

Deferral practices require that ranchers have alternate forage sources for this time period including extended feeding, use of other cultivated pastures with perennial or annual forages, or with the application of deferred rotation grazing which alternates the spring use period among multiple pastures from year to year (see Grazing Systems). Most ranchers in the study area defer grazing of native range until after May 15 through to June 15 and many until much later

into the summer. This means that the normal onset of grazing occurs in the later phase of nesting through to the middle and end of brood rearing.

The general life cycle of Sage-Grouse in Alberta is depicted in Figure 6 (Aldridge 2002; Alberta 2002). Normal deferral practices have the potential to reduce conflicts between cattle and Sage-

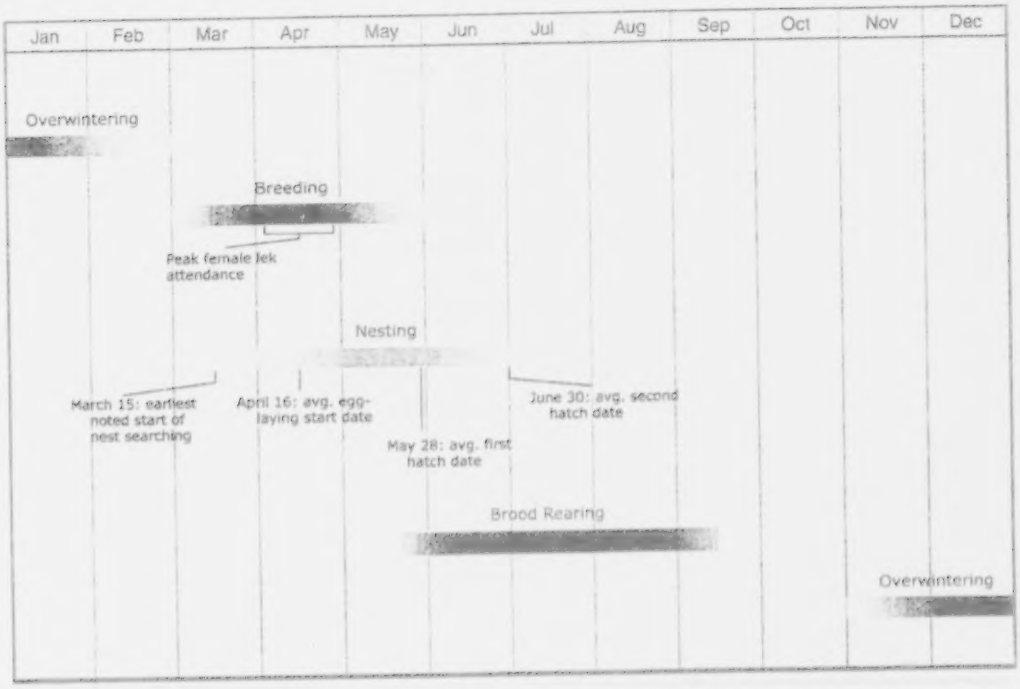

Figure 6 The major life cycle phases of Sage-Grouse in southeastern Alberta - adapted from Aldridge (2002) and Alberta (2002)

Grouse for all of the breeding and most of the nesting period especially for the first laying and hatch dates.

Beneficial Practices - Onset of Grazing

The normal practice of spring deferral provides two primary benefits for Sage-Grouse. Spring deferral will improve plant vigor and productivity of grassland plant communities thereby improving plant cover. Spring deferral will also reduce the potential conflicts between livestock and Sage-Grouse during breeding and nesting life cycle periods.

5.2.3 Livestock Distribution

Proper stocking rates alone will not ensure a desired overall intensity of grazing and many factors can influence the evenness of livestock distribution in a pasture unit including topography, vegetation diversity, livestock type, insects and weather (Holechek et al. 1998). In semi-arid environments or under drought conditions, the most influential factor is distance to water. As a rule, stock will graze about 1.6 km from water, and rarely beyond 3 km (Fraser et al. 1990).

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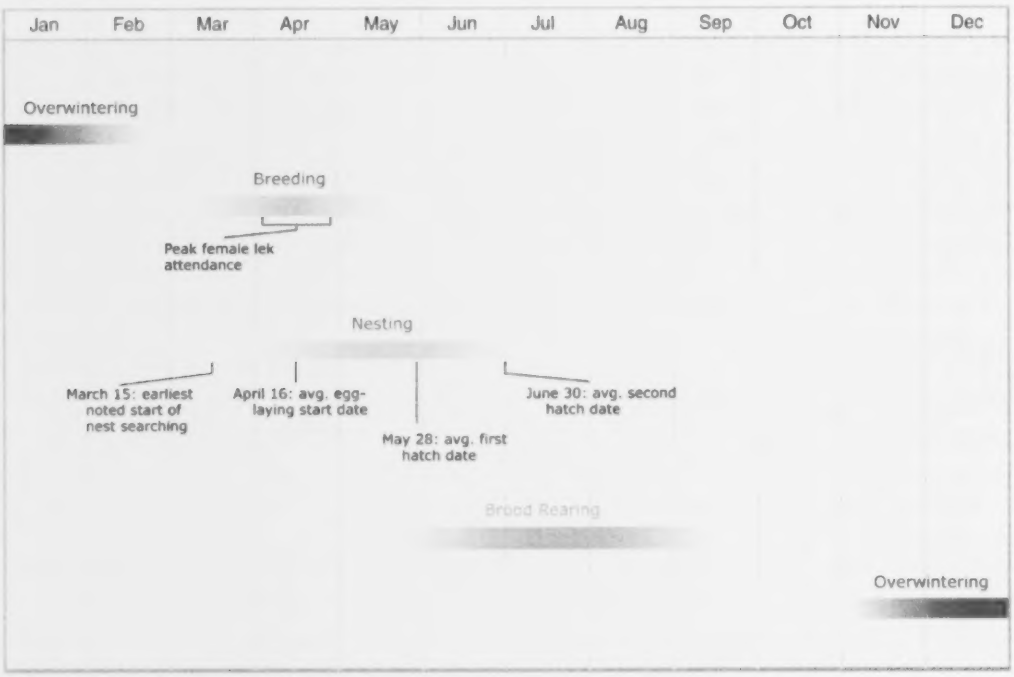

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Uneven livestock distribution is normally considered undesirable since heavier grazing impacts occur on preferred pasture areas. Uniform livestock distribution has generally been promoted by range managers to prevent declines in range health and forage productivity, especially when impacted areas become extensive in a pasture unit (Robertson et al. 1991). The goal of uniform livestock distribution has also been challenged recently by wildlife managers, since uneven distribution can be beneficial when it creates a gradient in grazing intensity from light to heavy (Bradley and Wallis 1996; Freilich et al. 2003). Desirable livestock distribution would include predominantly healthy prairie vegetation cover interspersed with patches of moderate to heavily grazed range. Problem areas would be preferred Sage-Grouse habitat where grazing impact is no longer patchy, but occupies broad zones of the pasture with uniform grazing impact at moderate-heavy to heavy grazing intensity.

Like most riparian areas, overflow sites will likely provide the longest availability of green and palatable forage relative to drier upland sites. The riparian pasture management concept (Adams and Fitch 1995, Fitch and Adams 1998) may be a beneficial practice in such circumstances. Where practical, extensive flood plain and overflow sites may be fenced as a separate pasture unit to allow a more customized grazing program relative to adjoining upland pasture.

Achieving acceptable livestock distribution is an adaptive process and specific practices may differ from ranch to ranch. Effective distribution requires the application of tools like salting, watering site development, herding and many other practices that will influence livestock grazing patterns and pressure in a pasture (Bailey et al. 1996). There is considerable interest at the present time in using strategically located livestock watering points as a very effective means to manipulate livestock distribution. Research programs have demonstrated the benefit of off stream watering to dramatically alter livestock distribution with the potential to improve livestock production performance (Willms et al. 2000).

Beneficial Management - Livestock Distribution

Managing livestock distribution to enhance wildlife habitat must be based upon on-site evaluation. Beneficial livestock distribution practices for Sage-Grouse would include reducing livestock preference for and impacts on preferred Sage-Grouse habitats (e.g. grazing impact at moderate-heavy and heavy intensity to a broad use zone). Where extensive flood plain or overflow range sites exists the riparian pasture concept may have merit to tailor grazing practices to a discrete landscape unit.

5.2.4 Grazing Systems

A grazing system is a plan or schedule for managing when and where livestock graze. Grazing systems are also strategies for making productive use of the available pasture resources in a manner that allows livestock production goals to be met while maintaining or improving range health and maintaining or enhancing other resource and wildlife habitat values (Holechek et al. 1998; Adams 1991). Key objectives of grazing systems include:

- reducing the length of the grazing season and providing more growing season rest,
- enhancing the amount of organic residue or litter on a given pasture,

- allowing range plants periods of deferral or rest during critical developmental stages (deferral to re-accumulate stored energy reserves or rest until seed production is complete),
- ameliorating or augmenting the patchiness of grazing, and
- applying specific practices to address natural resource or wildlife habitat objectives.

There is no "best" grazing system. Each farm or ranch unit is unique and several grazing systems may be applied on the same operation to take advantage of the unique mix of pasture resources that may exist on a given operation (multiple types of native range, seeded perennial or annual pasture, dryland or irrigated pasture, and crop residues). Grazing management must be flexible and tailored to each management unit. Designing the right system will depend on the ranch management goals in balance with other resource management objectives. Grazing systems require goal setting, implementation of a planned strategy, monitoring and adjustment or adaptation to be effective.

The following discussion of grazing systems for Sage-Grouse will start with the most generic grazing systems and then move progressively to the most specialized.

Season-long Grazing

Season-long grazing (some times called continuous grazing) involves generally spring and summer use of a pasture unit. In the broad context of Alberta rangelands, season-long grazing is not normally a recommended grazing system since livestock may graze through the growing season and make preferential use of certain plants and areas of a pasture. When applied with heavy stocking rates, season-long grazing will normally lead to overgrazing of a pasture unit. Under these circumstances preferred range plants are grazed and regrazed, receiving no growing season rest. Utilization of the pasture unit will be uniformly heavy and litter residue is diminished.

In the dry mixed grass prairie though, where productivity is very low and more intensive management treatments can be costly, season-long grazing can be applied to achieve basic conservation objectives with care and attention to light rates of stocking, deferral of spring grazing and application of livestock distribution tools. In the dry mixed grass, the period of active growth is comparatively short with most biomass production occurring within a six to eight-week period in May and June. Spring deferral of native pastures, through use of seeded annual or perennial forages, will ensure a desirable level of range readiness for range plants before grazing begins (termed complementary grazing). Also, given the more homogeneous character of dry mixed grass prairie livestock watering sites and salting can be used very effectively to spread livestock pressure over the landscape and minimize localized heavy grazing. Referring once more to the concept of range of natural variation, managers may recommend this type of grazing strategy to create patch diversity in the vegetation canopy. When considering the needs of Sage-Grouse, the chief shortcoming of this approach may be the tendency for livestock to graze and regraze moist/mesic sites where herbage production may occur over a longer time period and where livestock may be utilizing forage when it is desired for young birds.

Deferred Rotation Grazing

Deferred rotation grazing involves subdivision of the range landscape into smaller pasture units and then grazing the resulting pasture units in a planned sequence that changes from year to year so that each pasture receives deferral from early grazing. For example, in a three field deferred rotation, pasture 1 would be grazed first in year 1, second in year 2 and last in year 3. Through this approach the impacts of spring grazing are shared among fields and offset by periods of mid and late season grazing when pastures are essentially dormant. Deferred rotation provides better opportunities for preferred plants and pasture areas to gain vigor than with Season-long grazing (Holechek et al. 1998). At any given time, only one pasture has livestock in it while other pastures are receiving rest. Additional fencing and watering sites would be required to implement the grazing strategy. Use of deferred rotation grazing has enhanced litter levels and restored productivity on demonstration sites in southeastern Alberta (Adams et al. 1991, Adams et al. 1993).

For Sage-Grouse, two, three and four field deferred rotations would serve to limit the potential for livestock impacts to nesting sites to the early grazed field and provide pastures that would be rested from livestock grazing when young birds are seeking forage.

A possible disadvantage for other wildlife species is the move towards more intensive practices that reduce what might otherwise be described as "beneficial inefficiencies" in grazing use. Pasture utilization will tend to be more uniform and the overall gradient of heavy, moderate, light and very light grazing may be reduced.

Rest-Rotation Grazing

Though historically applied by many ranchers, the practice of rest-rotation grazing was first defined in the literature by Gus Hormay of the USFS in the 1950's (Hormay and Evanko 1958). In this system, one pasture unit will receive a full 12 months of non-use while other pastures are grazed, often in a deferred rotational sequence (Holechek et al 1998). A number of different variations of rest-rotation have been defined. Hormay proposed a variant where gates are left open as cattle move through the rotational sequence. This allows back grazing where animals have access to previously grazed pastures and can return to them at will. The back grazing option is to allow livestock to maintain weight gains. Hormay's system also proposed that while one pasture is rested, the remaining pastures absorb the normal load of grazing.

Most range managers would agree today that both concepts seem to defeat the primary objective of providing more rest and the accumulation of litter. For the purpose of enhancement of Sage-Grouse habitat, rest-rotation would be defined as 1 pasture rested for 12 months, with the other pastures grazed in a deferred rotation at desired stocking rates of light to moderate-light.

For Sage-Grouse habitat needs, rest-rotation grazing would likely be useful where the restoration of range health is desired as defined by low scores for plant community ecological status, community structure and litter variables.

Riparian Pasture Strategy

The Silver Sagebrush/Western wheatgrass (*Artemisia cana/Agropyron smithii*) community type on saline overflow range sites (described in section 3.0) is the driest of the riparian plant community types. The riparian pasture grazing strategy involves creation of separate pasture units where extensive flood plain or overflow site range sites may exist to permit separate grazing management of riparian landscape units from upland sites (Adams and Fitch 1995 and Fitch and Adams 1998). A more uniform grazing environment is created by reducing the amount of variation in vegetation and topography within the riparian pasture. The practice improves animal distribution and allows the manager to effectively control timing and intensity of grazing to address management objectives in the riparian landscape. For a riparian pasture unit to be practical, a sufficient acreage of the flood plain type would be required to create a grazable pasture unit.

To meet Sage-Grouse habitat needs, riparian pastures might be skim grazed in spring, at light rates for short time frame, to stimulate forb production and then grazed in late summer or fall after the brood rearing phase (sometimes referred to as a "switch back" grazing system).

Beneficial Practices - Grazing Systems

There is no single grazing system that would be best for Sage-Grouse habitat considerations. Grazing systems should be viewed as adaptive strategies that evolve over time to address specific management issues that may have negative impacts on Sage-Grouse habitat values. Management changes made to support Sage-Grouse habitat objectives may also negatively impact habitat needs of other wildlife species. Key considerations:

- To retain habitat values in season-long grazed pastures, spring grazing should be deferred, stocking rates at light to light-moderate maintained and livestock distribution tools applied. Season-long grazing with high levels of range health will contribute to patch diversity in the vegetation canopy.

- Deferred rotation grazing would provide the opportunity to improve plant vigor and rangeland health of pastures with low range health scores and also limit the potential for livestock impacts to nesting sites in the early grazed field. Deferred rotation would also provide pastures that would be rested from livestock grazing during the period when young Sage-Grouse are seeking forage.

- Rest-rotation grazing can be applied to restore degraded pastures where the plant community, community structure and litter reserves have been seriously reduced.
- The riparian pasture strategy may be applied to mesic/meadow riparian plant communities where a sufficient land area is available to create a viable pasture unit. A switchback style of grazing with skimming, rest and grazing may foster forb production.

5.2.5 Other Practices

Control of sagebrush has been a significant habitat modifier in the US, but in Canada, there are no recommendations sponsored by government agencies to consider sagebrush control as a legitimate rangeland maintenance treatment. It is questionable that sagebrush control treatments would prove to produce any cost benefits. Chemical companies that traditionally sponsor brush control research, currently express no interest in developing control treatments for silver sagebrush and are aware of the special status that sagebrush communities as key wildlife habitat (Grenveld, personal comm.). Efforts should be made to communicate with weed control specialists in Alberta Agriculture Food and Rural Development as well as the broader pesticide industry to ensure that in future the special status of sagebrush landscapes are recognized in brush management literature and guidelines.

Beneficial Practices - Other Practices

The special status of silver sagebrush and the threat to Sage-Grouse habitat posed by sagebrush control treatments should be clearly communicated with the weed control sector in government and industry and also highlighted in extension documents.

6.0 Summary

Beneficial Grazing Management Practices for Sage-Grouse in Southeastern Alberta

Purpose of Guidelines:

- To define beneficial grazing management practices for Sage-Grouse in southeastern Alberta to promote general awareness about grazing practices that support habitat needs and to facilitate adaptive range management projects.

Applying the Guidelines:

- The causes of Sage-Grouse decline in North America remain poorly understood. In general, it appears that an accumulation of impacts from a number of different land use activities has resulted in a serious decline in the species. It is important that each land use define best management practices that will minimize potential conflicts with Sage-Grouse and help to protect habitat.

- These guidelines link the life history and habitat requirements of Sage-Grouse to grazing management practices and represent the best current knowledge and science available. As such, the guidelines are a starting point for promoting grazing management practices that are harmonious with the habitat requirements of Sage-Grouse.

- Well managed livestock grazing has the potential to be in harmony with Sage-Grouse habitat needs. There are many shared landscape goals including managing for late seral plant communities and in maintaining plant community structure, plant vigor and abundant litter (organic residue from carryover).

- The guidelines should NOT be applied as a "cookie cutter" approach. The goal of resource managers should not be to encourage the identical practices on all ranches. Variability in management practices should support natural variability on the landscape.

- Management actions should be based on identified management needs. When applying the guidelines on a whole ranch or grazing lease basis, information about range resources, current range health and management practices should be used to formulate management priorities and recommend beneficial grazing management.

- Beneficial management practices for Sage-Grouse are in effect on many ranches in the study area at the present time.

- Range health assessment (Adams et al. 2003) should be considered as a coarse filter screening tool for identifying areas where beneficial improvements in range health might be achieved.

- The guidelines should be further evaluated and refined in the future.

- For a more detailed description of best management practices for Sage-Grouse, review Chapter 5.0 of this report.

Disclaimer:

- These guidelines are based on the principle of ecosystem management (Bradley and Wallis 1996) to apply the best ecological knowledge available to managing prairie ecosystems, monitor management and adapt over time.

- The "testing" of these guidelines will come through the process of adaptive management.

Goals - General Habitat Protection and Quality

- Conserve all existing lek, nesting, brood-rearing, and winter Sage-Grouse habitats.
- Manage rangelands for a high standard of rangeland health and treat all historical Sage-Grouse habitat as if it might one day be used again by the species.
- Promote the habitat conditions that support nesting and early brood-rearing success including the maintenance or recovery of shrub and herbaceous (native grasses and forbs) cover including residual cover to conceal sage grouse nests and broods from predation.

Management Actions

Grazing Intensity

- Apply stocking rates which achieve light to light-moderate grazing intensity to maintain plant vigour, productivity and abundant organic residue in the form of litter.
- Light to light-moderate grazing intensity in climax to late seral plant communities will foster patch cover with potential to stimulate forb production.
- Grazing intensity can be evaluated indirectly for a ranch, grazing lease or pasture unit by comparing grazing utilization records with recommended stocking rates. Initial calculation of stocking rates should also recognize and make adjustments for cow size.
- Range health parameters (Adams et al. 2003) can be used to evaluate grazing intensity. Plant residue in the form of litter can be evaluated in relation to litter standards for the appropriate ecological site. Low range health scores for plant community ecological status, structure, litter residue and increased bare soil, would serve as a screening tool for identifying sites where grazing intensity has been heavy in the past and where lighter stocking and more rest will be required to restore range health.
- The impacts of all grazers domestic and native need to be considered when establishing appropriate stocking rates.

Onset of Grazing

- Deferral of spring grazing will improve plant vigor and productivity of grassland plant communities thereby improving plant cover and also reduce the potential conflicts between livestock and Sage-Grouse during breeding, nesting and brood rearing life cycle periods.
- Grazing deferral until late spring will eliminate conflicts with nesting and minimize conflicts with Sage-Grouse nesting. Deferral to early summer will minimize conflicts with brood rearing.

Livestock Distribution

- Recommendations for livestock distribution, need to be based upon on-site evaluation and identification of problem impact areas.
- Desirable livestock distribution would include predominantly healthy prairie vegetation cover interspersed with patches of moderate to heavily grazed range.

- Problem areas would be preferred Sage-Grouse habitat where grazing impact is no longer patchy, but occupies broad zones of the pasture with uniform grazing impact at moderate-heavy to heavy grazing intensity.

- Planning tools are required for livestock producers to enable them to recognize preferred Sage-Grouse habitats.

- Where extensive flood plain or overflow range sites exist, the riparian pasture concept may have merit to tailor grazing practices to whole landscape units.

Grazing Systems

- There is no single "best" grazing system. Apply a flexible approach to grazing management that balances ranch needs with that of Sage-Grouse habitat considerations.

- Grazing systems should be viewed as adaptive strategies that evolve over time to address specific management issues that may have negative impacts on Sage-Grouse habitat values.

- Season-long (late-spring to summer) grazing with a high level of rangeland health should provide favorable habitat conditions for Sage-Grouse. Important management practices to foster patch diversity in the vegetation canopy would include deferral of spring grazing, light to light-moderate stocking rates and careful use of livestock distribution tools.

- Deferred rotation grazing may be considered to improve plant vigor and rangeland health of pastures with low range health scores. It will also reduce the potential risk for livestock to impact nesting sites. Deferred rotation would also provide pastures that would be rested from livestock grazing when young Sage-Grouse are seeking forage.

- Rest-rotation grazing can be applied to restore degraded pastures where the plant community, community structure and litter reserves have been seriously reduced. Rest-rotation grazing will facilitate regeneration of silver sagebrush plants if moisture is available to support re-sprouting.

- The riparian pasture strategy may be applied to mesic/meadow riparian plant communities where a sufficient land area is available to create a viable pasture unit. A potential adaptive grazing strategy to stimulate forb production may include a short-term, light-intensity grazing of the riparian pasture followed by rest (termed skim grazing). The pasture is then grazed later in the season when the pasture is in dormancy and Sage-Grouse brood rearing activities are complete.

Goal - Lek (Strutting Sites)

- Provide secure Sage-Grouse breeding habitat with minimal disturbance and harassment.

Management Actions:

- Avoid placing salt, minerals or supplements within 0.8 km. (1/2 mi.) of lek sites.

- The timing and location of livestock turnout and trailing should not contribute to livestock concentrations on leks during the sage grouse breeding season.

- Construct new livestock facilities (livestock watering facilities, water wells, fences, corrals, handling facilities, livestock oilers, etc.) an approved distance from leks to avoid concentration of livestock, collision hazards to flying birds, or avian predator hunting perches.

Goal - Wintering Habitat

- Protect and maintain silver sagebrush plant communities and where necessary encourage shrub regeneration to ensure adequate Sage-Grouse wintering habitat.

Management Actions:

- Supplemental winter feeding of livestock should not take place in key Sage-Grouse wintering habitats.
- Apply riparian grazing management strategies to overflow range sites to maintain or restore range health levels in silver sagebrush plant communities.
- Silver sagebrush stands burned by wildfires, should be given additional rest to facilitate recovery.

Goal - Range Management During Drought

- Minimize loss of habitat quality during drought periods.
- Encourage restoration of drought stressed rangeland when normal moisture patterns return.

Management Actions:

- Recognize the onset of drought conditions and apply drought management practices to maintain range health.
- Reduce stocking levels to balance livestock needs with the forage supply and maintain light grazing impact through use of supplemental feeds, crop residues, annual and perennial seeded forages.
- Review range management plans and the effect drought has had on range health and vigour.
- Plan and implement a grazing system that will promote quick recovery of the range by building plant vigour and re-establish litter reserves.

7.0 Future Research and Tool Development

1. Given the possible implications of the watershed study by McNeil and Sawyer (2003) on natural processes and functioning of silver sagebrush communities, future studies should consider the viability of these habitats. The functioning of silver sagebrush stands should be compared between impacted vs. relatively unimpacted drainages.

2. The current range reference area network in southeastern Alberta does not include sagebrush communities. A minimum of two new rangeland reference sites should be established to characterize silver sagebrush overflow sites. Exclosures should be a minimum two hectares in area with grazed and ungrazed monitoring treatments. These sites could be added to the Alberta Sustainable Resource Development rangeland reference area network in the Southeast Region to establish carrying capacity and litter threshold recommendations and be available for other sagebrush related field studies.

3. Despite the historic presence of fire, its value as a management tool is poorly understood. Future studies should examine the interaction of fire, silver sagebrush and habitat use by Sage-Grouse. In order to minimize risks to existing Sage-Grouse populations, fire research should be considered in sagebrush areas where there are currently no birds.

4. Communication tools are required that outline the habitat needs of Sage-Grouse as well as beneficial management practices. Tools should help ranchers to recognize the types of habitat they are managing (wintering, nesting, brood rearing, breeding) as well as key management priorities that may exist on their rangelands (i.e. increase litter cover, restore plant community structure, create patchiness, reduce impact in moist/mesic meadows and swales).

5. Future studies should examine the value of patchiness in the vegetation canopy resulting from grazing management practices on the enhancement of a desirable forb component in Sage-Grouse habitat.

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